DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

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1. BIND.

DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

General Reports

FÖRSTE BIND. (in 3 Vols)

CIRCULAR

from the *Editorial Committee* of

The Norwegian North-Atlantic Expedition.

The "General Report of the Norwegian North-Atlantic Expedition" is published in parts, each Memoir being distributed immediately on its leaving the press.

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DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

IV.

1. HISTORISK BERETNING.

MED ET KART.

2. APPARATERNE OG DERES BRUG.

MED ET TITELBILLEDE OG 21 TRÆSNIT.

AF

C. WILLE,
KAPTEJN I MARINEN.

CHRISTIANIA.
GRØNDAHL & SØNS BOGTRYKKERI.
1882.

I COMMISSION HOS H. ASCHEHOUG & Co

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THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

HISTORICAL ACCOUNT.

BY

C. WILLE,
CAPTAIN OF THE ROYAL NAVY.

WITH A MAP.

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1882.

Under 19de Marts 1874 indsendte Professorerne H. Mohn og G. O. Sars til den kongelige norske Regjerings Departement for det Indre en Forestilling saalydende:

Gjennem vore Studier af vort Lands Naturforhold ere vi komne til den Overbevisning, at Forklaringen og Forstaaelsen af disse maa søges hovedsagelig i Forholdene i det Hav, som omsluttes af Norge, Færøerne, Island, Jan Mayen og Spidsbergen. Denne Del af Verdenshavet danner et stort Bassin, i hvilke Atlanterhavets varme Vande støde sammen med Ishavets kolde. De Bidrag til Kundskaben om dette Hav, som hidtil foreligge, gjælde hovedsagelig alene Bækkenets Rand, og skyldes for den største Del Forskninger, anstillede af Expeditioner, udsendte fra fremmede Lande. Saaledes have de forskjellige Svenske og Franske Expeditioner til Spidsbergen givet udmerkede Oplysninger om Bassinets østlige Rand, og de fra England med Dampskibene "Lightning" og "Porcupine" i 1869 og 1870 udsendte Expeditioner have tilvejebragt Oplysninger om dets sydvestlige Rand mellem Skotland og Færøerne, der i mere end en Henseende maa kaldes epokegjørende. Hvor Havet støder op til Norges Kyst ere Forholdene inde ved Kysten blevne undersøgte dels ved vore Zoologers Arbeider, dels i de senere Aar ved de med Oplodningsdampskibet "Hansteen" udførte Expeditioner. Fra det aabne Hav derimod er det yderlig lidet, der er tilveiebragt af Oplysninger. Norske Sælfangere have vistnok siden 1867 jevnlig hver Vaar anstillet meteorologiske Iagttagelser og lejlighedsvis forsøgt Maalinger af Temperaturen i Havets Dyb, men i Forhold til Gjenstandens Storhed ere disse Resultater kun at betragte som de første Vink om de sande Forhold.

Hvad de fysiske Forhold angaar, have de Franske, og i langt højere Grad de Svenske Spidsbergens-Expeditioner foretaget Lodninger mellem Norge og Spidsbergen samt langs denne Øgruppes Vestside, der vise, at der mellem de nævnte Lande ikke er dybere end 270 Favne, og Lodninger fra flere Tyske Expeditioner have godtgjort, at hele Østishavet mellem Norge, Spidsbergen. Novaja Semlja og Nord-Rusland danner et eneste Flak, der grunder op mod disse Landes Kyster.

On the 19th of March 1874, Professors H. Mohn and G. O. Sars memorialized the Home Department of His Norwegian Majesty's Government as follows: —

A careful study of the physical and biological conditions peculiar to our native country, has convinced us that the means whereby to comprehend and explain them must be sought chiefly in a thorough exploration of the Sea stretching between Norway, the Færoe Islands, Iceland, Jan Mayen, and Spitzbergen. This part of the Ocean constitutes a wide basin, in which the warm water of the Atlantic meets the cold indraught from the Polar Seas. Our present knowledge of this ocean-tract refers principally to the margin of the basin, and is in greater part a result of Expeditions despatched by foreign countries. Thus, for instance, the various Swedish and French Expeditions to Spitzbergen have contributed very materially to furnish information concerning the eastern margin of the basin, and those sent out from England with the "Lightning" and the "Porcupine," in 1869 and 1870, have, as regards the south-western margin, between Scotland and the Færoe Islands, supplied data that may be said to mark an epoch in the history of marine research. The strip of ocean immediately adjacent to the Norwegian coast, has been investigated partly by our zoologists in the course of their labours, and partly on the annual expeditions of the Coast Survey, with the steamship "Hansteen." But as to the open sea, what we as yet know is meagre in the extreme. True, meteorological observations have, since 1867, been taken every spring by captains of Norwegian sealers, who now and again will make attempt to determine the temperature in the depths of the ocean; but such results must, compared to the magnitude of the problem, be regarded as mere intimations of the truth.

With respect to physical conditions, soundings were effected on the French, and more especially on the Swedish, Spitzbergen Expeditions, between Norway and Spitzbergen and along the western shores of that group of islands, showing the depth of the ocean between the said countries to be nowhere greater than 270 fathoms; and from soundings taken on divers German Expeditions, the whole eastern section of the Arctic Ocean is known to constitute an immense flat, shoaling gradually up to the coasts of Norway, Spitzbergen, Novaja Zemlja, and Northern Russia.

Vestenfor Linien mellem Tromsø og Spidsbergen og vestenfor samt nordenfor denne Ø styrter derimod Bunden sig ned til et stort Dyb, der midt imellem Spidsbergen og Grønland maaler 2650 Favne, en Dybde, der rivaliserer med selve Atlanterhavets. Fra den nordlige Side af Bassinet haves ingen Lodninger; kun ved man, at den vulkanske Ø Jan Mayen styrter sig meget brat ned i Havet. Heller ikke ved man, hverken hvorledes Bankerne paa Islands Vestkyst eller Flakket mellem Island og Færøerne gaa over til Ishavsdybet. Forholdene mellem Færøerne og Skotland ere derimod nøie undersøgte af "Porcupine"-Expeditionen i 1869. Her gaar fra Ishavet en smal Rende paa 600 Favnes Dyb ned i Atlanterhavet. Denne Rende samt den formodentlig dybe Rende mellem Island og Grønland synes at være de eneste Communicationsveje i Dybet mellem Atlanterhavet og vort Ishav. Paa den norske Side strækker Kundskaben om Havbundens Form sig saagodtsom ikke udenfor de af Fiskerne besøgte og af "Hansteen"-Expeditionerne opdoddede Banker. Kun paa et eneste Sted, ved Storeggen, have disse Lodninger antruffet en rask Heldning af Bunden ud mod det store Hav-Bassin. Ellers ere vi totalt uvidende om, paa hvilken Maade vor Kysts Banker gaa over i Ishavsdybet, om det sker brat, eller langsomt, om det sker nær Kysten eller om det først finder Sted langt ude i Søen. Kundskaben om dette Punkt er det netop, som vi maa anse det for et Hovedpunkt at vinde.

Med Hensyn til Temperaturen i det her omtalte Strøg af Havet er vor Kundskab indskrænket omtrent til de samme Localiteter, som de hvor Dybdeforholdene ere undersøgte. Temperaturmaalingerne fra vor Kyst vise, at vore Banker og vore Fjordes tildels store Dyb dækkes af Vand, hvis forholdsvis høje Varmegrad viser hen til Atlanterhavet som dets Udspring. Intetsteds langs Norges Kyst er der paa Bankerne eller Fjordenes Bund fundet Kuldegrader. Saadanne ere derimod fundne ikke alene saavel i Overfladen som i Dybet ude i Havbassinets centrale Del og henimod dets vestlige Rand, men ogsaa i den dybe Rende mellem Færøerne og Shetland allerede i 300 Favnes Dyb.

Hvor langt vi maa gaa ud i Havet vestenfor Norge forat træffe paa iskoldt Vand paa Bunden, derom staa vi aldeles blottet for Kundskab. Her staa vi atter ved et Hovedpunkt, thi denne Grændse mellem det varme Atlanterhavsvand og det iskolde Polarvand maa, efter det hvad der kan sluttes af lignende Forhold, betegne Grændsen for de i Havet levende Væseners forskjellige Udbredelse til den ene eller til den anden Side. End ringere end vor Kundskab om Dybde- og Varmeforhold er vor Kundskab om Strømforhold, der spiller en saa stor Rolle i Dyrelivet, om Havvandets Bestanddele, der er af lige Vigtighed, og om de jordmagnetiske Forhold, der for Theorien som for Skibsfarten er af sær Betydning.

West of a line extending between Tromsø and Spitzbergen, as also west and north of the latter locality, the bottom sinks to a great depth, reaching between Spitzbergen and Greenland 2650 fathoms, and accordingly rivalling that of the Atlantic itself. Along the northern boundary of the basin no soundings have as yet been taken; all we know is, that the volcanic island of Jan Mayen plunges precipitately into the ocean. Nor is it yet known how or where the banks on the west coast of Iceland and the flat between Iceland and the Færoe Islands, pass into the depths of the Arctic Ocean. The section stretching between the Færoe Islands and Scotland, was, on the other hand, carefully explored on the "Porcupine" Expedition, in 1869. In this tract, a narrow channel, 600 fathoms deep, extends from the Arctic Ocean to the Atlantic. This channel, and probably too the deep channel between Iceland and Greenland, would appear to be the only highways by which the depths of the Atlantic are connected with those of the Arctic Ocean. Along the Norwegian coast, what we know of the nature and contour of the bottom is almost exclusively confined to that of the banks periodically visited by fishermen, and which of late years have been investigated on the Coast Survey expeditions with the "Hansteen." In but one locality — off the Storeggen bank — was the bottom found to sink rapidly down to the great ocean-basin. With this exception, we are totally ignorant as to how and where the banks lying off the coast of this country pass into the depths of the Atlantic, whether gradually or precipitately, whether in close proximity to the coast or possibly in mid-ocean. Now, the solution of this problem appears to us of the greatest importance.

As regards the temperature throughout the aforesaid ocean-tract, it is known only for most of the localities in which the depth has been measured. The comparatively high temperature distinguishing the water on our coastal banks and in our fjords, many of which are of great depth, points to the Atlantic Ocean as the source whence it is derived. Nowhere along the coast of Norway, whether on the banks or at the bottom of the deepest fjords, has 0° been observed; but in the central part of the ocean-basin, and at its western margin, the temperature has been found to be below zero, both at the surface and in the depths; nay, in the deep channel between the Shetlands and the Færoe Islands 0° is reached at a depth of 300 fathoms.

At what distance from the western shores of Norway the glacial bottom-area commences, we are unable to infer from the data as yet obtained. Here, then, we stand in face of another highly important question; for the limit at which the warm water of the Atlantic meets the cold indraught from the Polar Sea, must, reasoning from analogy, mark the limit of distribution for the animals inhabiting the warm and cold areas. But, trifling as is our knowledge of depth and temperature in that ocean-region, we know still less concerning the nature of its currents, — a physical condition which everywhere exerts such great influence on the character of the marine fauna, — concerning the chemical constituents of its water, — no less important in

Af hvad vi hidtil vide om det Hav, som omgiver Norges Kyster, kunne vi erkjende, at det er dette Hav, hvem vort Land skylder sin Existents som beboet og som civiliseret Land. Gaar man til de samme Breddegrader i Asien eller Amerika, træffer man kun Is-Ørkener, der sparsomt beboes af nomadiske Folkestammer. Det milde Klima, som i Norge gjør Landbruget, vor vigtigste Næringsvej, mulig, skyldes det varme Hav, som beskyller vore Kyster. Dette Havs Varme er ikke indskrænket til Overfladen: i saa Fald vilde dets Varmekraft snart være forbrugt under den lange Vinter; men, som anført, findes paa Kystens Banker og Fjordenes Dyb varmt Vand, der gjennem den lange Vinter, naar den koldere Luft stadig trækker Varme fra det varmere Vand, er det Reservoir eller den Ovn, som stadig forsyner Luften med Varme, og hvis Varmemængde er saa stor, at den holder ud den strengeste Vinter uden at tabe noget merkeligt af sin Varmeevne. Udenfor Bankerne have vi i Dybet Ishavets iskolde Vande, der fylde Færø- Shetlands-Rendens nederste Halvdel. Mod disses Indtrængen til Landet danne Bankerne den beskyttende Vold, de holde de iskolde Vande langt borte fra Kysten og hindre dem fra at trænge ind i vore Fjordes Dyb. Uden disse Banker skulde vi visselig i Norge have Grønlands Klima. Bankernes Udstrækning mod Vest eller Nordvest er saaledes en capital Sag for hele vor Tilværelse — men hidtil er den os ganske ubekjendt. De varme Vande, der flyde nordover fra Atlanterhavet, have en stadig Tendents til at gaa til højre, altsaa til at kaste sig ind paa Europas Vestkyst. Her møde de vore Banker, over hvilke de flyde. Denne Omstændighed er af den største Betydning. Thi Exempler fra andre Steder, f. Ex. fra Færø-Shetland-Renden, vise, at hvor de varme Vande flyde over et Underlag af iskoldt Vand, foregaar der fra dette en sterk Afkjøling, der endog naar til Overfladen, og saaledes bidrager til at gjøre Klimatet koldere. Men hvor det varme Vand flyder over en Landbund, der tjener denne til at bevare dets Varme i lange Strækninger. Det skyldes derfor vore Bankers Udstrækning, at Atlanterhavets varme Vande uden nogen sterk Afkjøling kunne omslynge vore Kyster helt op til Grændsen mod Rusland og videre. Den Udholdenhed, som det varme Vand har til at modstaa Vinterens Strenghed, beror foruden paa Landbundens, det er Bankernes, Udstrækning ogsaa paa deres Dybde — men derom have vi ikke Kundskab uden for den smale Rands Vedkommende, som de senere Aars Dyblodninger langs Kysten har skaffet os Kundskab om.

their operation, — and finally, concerning the phenomena of terrestrial magnetism, which, bearing as they do alike on science generally and on practical navigation, are of peculiar significance.

From the facts as yet determined respecting the sea that laves our shores, we may safely assume, that to its waters is Norway indebted for her existence as a habitable and civilised country. In Asia and America, the land within the same parallels of latitude constitutes a vast icy waste, thinly peopled by nomade tribes. The mild climate of Norway, indispensable for the prosecution of agriculture, whereby the great bulk of the population subsists, depends mainly upon the high temperature of the sea surrounding our coast. The heat given off by the water is not derived exclusively from the surface; were such the case, its source would soon be exhausted during the long northern winter; but, as previously stated, water of a high temperature is found on the banks and in the depths of the fjords, which, throughout the long winter, when the cold air is incessantly drawing off heat from the sea, constitutes, so to speak, a reservoir whence the atmosphere is supplied with heat; and the amount in store is much too great to admit of being sensibly reduced by the longest and most rigorous of winters. Without the banks, we have the cold water from the Arctic Ocean, filling the lower half of the channel between the Færoe and the Shetland Islands. Now, it is these banks that form a protective barrier, effectually preventing the cold water from forcing a passage to the coast, and from mingling its waters with those in the depths of our fjords. Deprived of these banks, Norway would assuredly have the climate of Greenland. Hence their extent in a westerly or north-westerly direction is a question of vital importance to the people of Norway, yet concerning which we have at present everything to learn. On its northward course, there is a marked tendency in the warm Atlantic water to keep to the right and bank up against the western coast of Europe. Here it reaches our banks, over which it passes. But this is a most important fact; for whenever a warm current flows over a substratum of cold water, as is the case in the channel extending between the Shetlands and the Færoe Islands, it parts with a considerable portion of its heat, being cooled up to the surface, and thus contributes towards the severity of the climate; but where the warm water flows directly over the bottom, it will retain its heat for a very considerable distance. Hence it is the magnitude and extent of our banks that enables the warm water of the Atlantic, without being deprived of any great amount of heat, to compass our shores as far north as, nay farther than, the Russian frontier. The tenacity evinced by this water in retaining its high temperature, how intense and protracted soever may be the cold, is due, not only to its flowing for a long distance in immediate contact with the bottom, or to the extent of the banks, but likewise to the depth in those localities. As regards these conditions, however, all that we know has reference solely to the narrow belt along the coast in which of late years soundings have been taken.

Med Hensyn til Dyrelivets Forhold i den omhandlede Havstrækning er vor Kundskab omtrent paa det samme Trin som med Hensyn til de fysiske Forhold. Denne Havstrækning er hidtil saagodtsom slet ikke undersøgt og meget synes at ladè formode, at Dyrelivet her saavel oppe i Søen som paa de største Dyb vil vise sig særdeles rigt udviklet. Navnlig vil der til de paa de store Dybder (som her gaa ned til over 2000 Favne) levende Dyrformer knytte sig en ganske særlig Interesse ikke blot i zoologisk men ogsaa i geologisk Henseende, da det allerede har vist sig, at saadanne Dybvandsdyr ofte kunne aabne os ganske uventede Indblik i vor Jordklodes tidligere Forandringer. Det lidet vi til Dato kjende om de fysiske Forhold i den omtalte Havstrækning, tør nu ogsaa lade os formode, at der efter al Sandsynlighed her vil findes et rigere og mere varieret Dyreliv i Dybet, end maaske i nogen anden Del af Verdenshavene, og at man derfor netop her lettest vil kunne faa løst mange endnu uafgjorte Spørgsmaal vedkommende Dyrelivets Udbredning i Havets Dybder og Forhold til tidligere Jordperioders Dyreliv. De engelske Expeditioner med "Lightning" og "Porcupine" have allerede tilstrækkeligt vist os, hvilket vidt Felt for fremtidige Undersøgelser, berørende de vigtigste Spørgsmaal i Naturvidenskaben, der her ligger aabent for os, og det er ganske naturligt, at den videnskabelige Verden ogsaa venter, at der fra vort Lands Side skal gjøres noget til Fremme af en Sag, der er af saa stor Betydning for Videnskaben og hvori allerede saa mange Nationer have taget virksom Del.

Vi have ogsaa en dobbelt Opfordring hertil, da der ved Siden af de rent videnskabelige Resultater ogsaa kan ventes opnaaet Resultater af stor praktisk Betydning for vort Land. At Undersøgelserne af de fysiske Forhold i denne Havstrækning vil give vigtige Bidrag til Bedømmelsen af Vejrforholdene langs vor meget befærdede Vestkyst og derved altsaa komme Kystbefolkningen tilgode under dens haarde og farlige Bedrift tilsøs, er vel utvivlsomt. Ogsaa er det at vente, at mange Spørgsmaal vedkommende vore vigtigste Fiskerier herved vil kunne løses. Navnlig gjælder dette de for vort Land saa vigtige Sildefiskerier. Som allerede Undertegnede Sars har udtalt, er der al Sandsynlighed for, at de store Sildemasser, der om Vinteren og Vaaren besøge vore Kyster, netop have sit egentlige Tilhold i den omtalte Havstrækning, og at de Variationer, som gjennem Tidernes Løb ere iagttagne ved Vaarsildfiskerierne, væsentlig afhænge af og betinges af de forskjellige meteorologiske Forhold i det udenfor liggende Hav.

Den store saavel videnskabelige som praktiske Interesse, der saaledes knytter sig til Kundskaben om vort Vesterhavs Naturforhold, gjør det i mange Henseender ønskeligt, at en saadan Kundskab erhverves saa snart og saa fuldstændigt som muligt. En gradevis Fremgangsmaade med Benyttelse af de forhaandenværende Hjelpemidler vil

Of the fauna inhabiting the tract of ocean referred to in this Memorial, our present knowledge is no less limited than of its physical conditions. This extensive region has never yet been made the field of zoological investigation; and there is much to warrant our assuming, that the animal life prevailing there will prove to be distinguished alike at the surface and in the greatest depths by a high degree of development. And moreover, peculiar interest will attach to forms of animal life occurring in the great depths (upwards of 2000 fathoms), not only from a zoological, but also from a geological point of view, inasmuch as deep-sea animals have frequently afforded an unexpected insight into the earlier transformations of our planet. From the little at present known of the physical conditions distinguishing the aforesaid ocean-tract, we may infer, that, inhabiting its depths, will be in all probability found a fauna more extensive and varied than, perhaps, in any other part of the ocean; and hence that we may rely on its furnishing exceptional facilities for the elucidation of many still unsettled questions touching the occurrence of deep-sea animals, and the conditions affecting animal life in former geological periods. The results of the British Expeditions with the "Lightning" and the "Porcupine" have shown us how wide a field of research this subject opens, bearing as it does on the weightiest problems in Physics and Natural History; and it is but natural that our country should now be expected to contribute her quota towards the advancement of a cause so important to the interests of Science, and in which so many nations have already taken active part.

Besides, we have in this case an additional motive to impel us, since, apart from scientific expectations, there is reason to conclude that great material advantage would accrue to the country at large. Thus, for instance, a thorough investigation of the physical conditions peculiar to the said ocean-tract, must very materially assist in throwing light upon the meteorological influences so potent in determining the weather on our western shores, and thereby render special service to the coastal population when engaged in their arduous avocations. Moreover, many now open questions affecting the most important of our fisheries, would, we may reasonably opine, be elucidated. This refers in particular to the great periodical herring-fisheries. As already suggested by one of your memorialists (Sars), it is in all probability this tract of ocean within which lie the true haunts of those enormous shoals of herrings that in the winter and spring annually repair to our shores; and the marked irregularity of occurrence, observed, in the course of years, after a longer or shorter interval, to distinguish these fisheries, may no doubt be traced to meteorological influence at work off the coast.

Hence, as very great benefit would assuredly result alike to Science and to the material interests of the nation from an intimate knowledge of the physical and biological conditions distinguishing the Norwegian Seas, the sooner and the fuller, in our judgment, that knowledge be acquired, the better. A gradual mode of procedure, using

her ikke strække langt til. De norske Skibe, som fortrinsvis besøge disse Farvande, ere Sælfangerne. Fra disse kan man fremdeles vente Bidrag til Kundskab om Havets Vejrforhold, der efterhaanden ville sætte os istand til at lære disse vigtige Momenter for Dyrelivet og Havboernes Vandring at kjende. Sælfangernes Ophold i disse Egne foregaar dog kun til en Del af Aaret, Marts til Juni, og tildels langt Nord og inde i den med Drivis belagte Del af Havet, som udgjør den allernordligste Del af det Felt, hvortil vi her sigte. Endel norske Fartøjer fare tildels et godt Stykke udenfor Kysten til og fra Arkhangel om Sommeren. Ogsaa fra en Del af disse kunde man erholde meteorologiske Iagttagelser. Hvad der paa denne Maade kunde indvindes af Oplysninger, vil det meteorologiske Institut bestræbe sig for at lade komme til Nytte for den attraaede Kundskab om Havets Vejrforhold. Videre end til saadanne Iagttagelser kunne Handelsmarinens Bestræbelser ikke naa. Det har vist sig, at der med Maalingen af Havets Temperatur i Dybet om Vinteren for Sælfangerne er forbunden særegne Vanskeligheder, der have gjort mere end en Skibsførers ufortrødne Bestræbelser til Intet. Mere kunde vistnok udrettes, om en Videnskabsmand medfulgte et saadant Fartøj. Men da denne ikke kunde dirigere Skibet hen til de Steder, hvor hans Undersøgelser vilde være af størst Interesse, og Sælfangerne, som nævnt, opholde sig den meste Tid udenfor det Felt, der nærmest skulde være Gjenstand for den mest lovende Undersøgelse, vil ogsaa et saadant Middel blive for kortrækkende.

Vi blive saaledes staaende ved den Overbevisning, at Undersøgelsen af Havet vestenfor Norge, for at blive effectiv, maa udføres ved en dertil bestemt og udrustet videnskabelig Expedition. Som Forbillede for en saadan staa de Britiske Expeditioner med "Porcupine" og "Challenger". Den sidste, der gjælder alle de store Verdenshave og har en stor kraftig Dampcorvet til sin Disposition, er udrustet med alt hvad der til dens Øjemed kan fordres og er sit Land i enhver Henseende værdig. Saa storartet et Apparat vil til Undersøgelsen af vort Hav ikke være nødvendigt. Vi ville i enhver Henseende være hjulpne med en Expedition saadan som den med "Porcupine".

Fra den Norske Stats Side har der, uagtet saamange af vore Interesser knytte sig til Havet, ikke været foretaget nogen Expedition af videnskabelig Art til de os allernærmest omgivende Have. Undersøgelsen af de for vore nordlige Egne saa vigtige Fangstfelter i Nordishavet har ene og alene været overladt til den private Foretagsomhed, som her foruden de rent praktiske Resultater have medbragt skjønne Resultater for Videnskaben, saavel for Geografien som for Naturvidenskaben. Vi kunne nævne Carlsens Omsejling af Spidsbergen, hans Indtrængen i det kariske Hav, hans og Tobiesens samt senere Altmanns, Nilsens og

to their full extent the limited means now at our disposal, would certainly fail of its object. The Norwegian vessels that navigate those regions are mostly sealers. From this source we may indeed still hope to learn further valuable particulars of meteorological phenomena, which may eventually lead us to a juster estimate of their influence on animal life and the migratory instincts observed in the inhabitants of the deep. Meanwhile, the sojourn of our sealing-ships in those high latitudes is confined to part of the year only (from March to June), the vessels keeping, too, nearly the whole time, among the drift-ice, which constitutes the extreme northerly limit of the tract referred to. Moreover, the Norwegian ships that trade to Archangel, and which could also furnish meteorological observations from the open sea, do not extend their voyages beyond the summer months. Of all information from these sources. the Meteorological Institute will of course take advantage, to extend our knowledge of the causes determining the weather at sea. With other and more intricate observations it does not lie in the power of the merchant-navy to furnish us. Observing the temperature at any considerable depth in winter, is attended with very great difficulty, so great indeed as to have rendered worthless more than one captain's indefatigable exertions. True, greater results might be obtained were a gentleman whose profession was science to accompany such a vessel; but even in that case he could not shape her course and visit the best localities for observations; besides, the Norwegian sealers keep most of the season without the tract which, in preference to any other section of those Northern Seas, it is desirable to select as the field of exploratory research; and hence the alternative offered has little to advocate its adoption.

In face of the facts set forth above, we will emphasize our previously expressed conviction, that, in order to investigate effectively the tract of ocean stretching west of the shores of Norway, a special expedition must be despatched. As models we have the "Porcupine" and "Challenger" Expeditions. The latter, which has for its object the exploration of the great Oceans of the globe, is furnished with a powerful steam-corvette, has been fitted out on a scale commensurate with its importance, and is in every way worthy of the British Nation. But means so extensive and costly are not required for investigating the Norwegian Seas: an Expedition similar, for instance, to that sent out with the "Porcupine," would certainly be adequate for the attainment of the end proposed.

Though so many of our national interests are directly connected with the sea. no Scientific Expedition has yet been undertaken by the State to those parts of the ocean that lie next adjacent to the Norwegian coast. The exploration of the extensive sealing-grounds in the Arctic Ocean has been left altogether to private enterprise. which, apart from merely practical results, has enriched Science in the several branches of geography, physics, and natural history. As a few instances in point, we have only to mention Carlsen's circumnavigation of Spitzbergen, his exploring voyage far into the Kara Sea, and the discovery,

Johnsens Opdagelse af Kong Karl-Land, der saa længe svævede som en Taage for Geograferne, Tobiesens Iagttagelser fra Overvintringer paa Bjørne-Øen og paa Novaja Semlja, Johansens og Macks Omseiling af Novaja Semlja og Opdagelse af det varme Vand udenfor Obs og Jeniseis Mundinger. Ved disse Resultater har Norge kunnet hævde en Plads som Deltager i de Opdagelser, hvormed en Række af Nationer have bidraget til at sprede Lys over vor Planets nordligste Egne, og denne Plads har været en ærefuld selv ved Siden af de rigere Nationer med deres ganske anderledes vel udrustede offentlige og private Expeditioner.

Imidlertid tro vi, at Udrustningen af en egentlig Nordpol-Expedition, med det Maal at trænge frem i hidtil uudforskede Polar-Egne, ikke bliver vor Sag. Dette maa vi overlade til de rigere Nationer. Men naar der lige udenfor vor Kyst ligger et Hav, der indeslutter Ophavet til hele vor Existents, og dette Hav hidtil er saagodtsom ganske ukjendt i dets Naturforhold, da ligger Undersøgelsen af disse os Nordmænd nær og nærmere end nogen anden.

En videnskabelig Undersøgelse af Havet udenfor Norges Vestkyst er en Opgave, som fra norsk Side visselig skulde kunne udføres med samme Held som de Britiske Expeditioner af samme Art. Den maatte gaa ud paa at undersøge Havets Dybde, dets Temperatur, dets Vands chemiske Sammensætning og Gasindhold, dets Strømninger saavel i Overfladen som i Dybet, Bundens Beskaffenhed og geologiske Formation, dets Vejrforhold, de magnetiske Forhold og særlig dets Dyre- og Planteverden af enhver Art. Som Resultater af en saadan Undersøgelse kan man vente at erholde Oplysning om alle de Naturforhold, der betinge vort Lands Klima med dets Variationer og fremfor Alt om vore vandrende Fiskearters biologiske Forhold. Af hvilken Interesse saadanne Resultater vilde være for den hele Naturvidenskab, skulle vi ikke her videre udbrede os over; alene de vigtige Resultater, som kunne gjøres Regning paa for vore Fiskerier forekommer det os at være nok at henpege paa for at motivere en saadan Undersøgelses Ønskelighed. En til en saadan Undersøgelse udsendt Expedition maatte gaa ud fra den norske Kyst nordenfor Stat som sin Basis, og fra denne af studere Forholdene ud over Bankerne lige til selve Ishavsdybet, en Opgave, som den for Dampskibet "Hansteens" Oplodninger lagte Plan ikke tillader dette at udføre, paa samme Tid som "Hansteens" Arbeider ville bidrage i højeste Grad til at støtte den til Havets Undersøgelse udsendte Expeditions Arbeider. En anden Tilslutning vilde Hav-Expeditionen have til de Britiske Expeditioners Arbejde, navnlig til "Porcupine"-Expeditionens. Den vilde give denne, der nærmest er at anse for en Pioner-Expedition paa disse Felter, den rigtige Udvidelse og Afrunding i Retning af Polarhavet og saaledes mødes med al mulig Sympathi af de Britiske For-

first by that enterprising seaman and Tobiesen, and, some years later, by Altmann, Nilsen, and Johnsen, of Kong Karl's (Wyche) Land, which had so long flitted mirage-like before the minds of geographers; Tobiesen's valuable observations, taken when wintering on Beeren-Eiland, and on Novaja Zemlja; Johansen's and Mack's circumnavigation of Novaja Zemlja, and their discovery of the warm surface-water off the mouths of the Ob and the Yenisei. The exertions of these Norwegian mariners have given to their country her full share in the discoveries that have helped to throw light on the most northerly regions of the globe, thus securing to her an honourable position by the side of wealthier nations, with their numerous Expeditions, either fitted out at the expense of the State or by private munificence.

Meanwhile, a "North-Pole Expedition," having for its object the exploration of unknown Arctic regions, does not, we conceive, come within the scope of Norwegian enterprise. Such an undertaking must be left to nations better able to make the pecuniary sacrifice it would entail. But, off our coasts extends a tract of ocean which is the origin and preserver of our existence as a civilised nation; and that expanse of sea being as regards its physical conditions well nigh unknown, on Norway should first devolve the labour of their solution.

A scientific exploration of the sea west of Norway might certainly be accomplished by Norwegians with success equal to that which has attended the like British Expeditions. It would comprise the depth of the sea, its temperature, the chemical composition of its water, the currents prevailing there, both at the surface and in the depths, the nature and geological formation of the bottom, meteorological and magnetical phenomena, and more especially all forms of animal and vegetable life. The results of such an investigation might be expected to throw light upon the physical conditions determining our climate, and, above all, upon the biological characteristics of our migratory fishes. What value the acquirement of such information would have for Science generally, we will not dwell upon here; the great advantage which in all probability our fisheries would reap is alone sufficient to show the importance of such an undertaking. An Expedition with the object here set forth, would have as its basis the Norwegian coast north of Stat, and from this locality would proceed to investigate the banks, exploring thence down to the deepest parts of the basin, — a scheme that does not come within the limits of the plan laid down for the sounding-operations of the Coast Survey with the "Hansteen," the results of which would, however, very materially contribute to facilitate the scientific work of the Expedition. Moreover, a Norwegian Expedition must derive additional importance from its intimate relation to British Expeditions, and more especially to that despatched with the "Porcupine," since it would furnish the very desirable opportunity of carrying on and completing in the direction of the Arctic Ocean the work begun by the "Porcupine" Expedition (which bore a true pioneering character), and hence be met with the warmest sympathy

skere. Herom have vi allerede modtaget Vidnesbyrd fra disse Kanter. Paa samme Tid have vi og bragt i Erfaring, at den Britiske Regjering ikke agter at lade „Challenger" overtage denne Undersøgelse af vort Ishavsbækken, som vi her have for Øie.

Til Udførelse af Expeditionens Arbejder kræves en Zoolog med et Par Assistenter, en Fysiker og en Chemiker, forsaavidt det Videnskabelige angaar. Til Arbejdstid maatte vælges de roligste Sommermaaneder, thi med uroligt Hav er Arbejdet i de fleste Retninger umuligt. $2^1/_2$ Maaned, fra Midten af Juni til Slutningen af August er den længste Arbejdstid, man kunde gjøre Regning paa, og af denne Tid vilde mange Dage ikke kunne benyttes, naar Vejret er uroligt.

Af de til Expeditionen fornødne Apparater er Skibet det vigtigste og kostbareste. Et saadant maatte være et Dampskib, der besad tilstrækkelig Kraft til at manøvreres for Maskinen i ethvert saadant Vejr, hvori Undersøgelser af Havdybet overhovedet kunde foretages; det maatte kunne medtage Kul for en længere Tid og have en brændebesparende Maskine, have flere Baade til forskjellige Undersøgelser og et tilstrækkeligt Mandskab til Udførelse af alle med Dybvandsundersøgelser forbundne, ikke ganske lette Arbejder. Til disse udfordres ogsaa et Dampspil. Desuden udfordres et Arbejdsrum for de videnskabelige Undersøgelser, som kunne udføres ombord.

Efter de Undersøgelser, vi ved Sagkyndiges Hjelp have anstillet, findes der blandt norske Dampfartøjer for Tiden ikke noget, som opfylder de nævnte Betingelser. Med Hensyn til Tilvejbringelse af et passende Fartøj for Expeditionen stiller der sig nu trende Alternativer.

A. Anskaffelsen af et nyt Skib. Med Hensyn til dette Punkt ere vi saa heldige at kunne nævne et Overslag over dets Kostende, som er blevet os velvillig meddelt af Nylands mekaniske Verksted. Dette Verksted har nemlig fra den russiske Regjering modtaget Opfordring til at udarbejde Overslag over Omkostningerne ved Anskaffelse af et nyt Jerndampskib, med Skrue, skikket til Opsyns- og Opmaalingsfartøj, af en Størrelse og med en Udrustning og Indredning, som paa det allernærmeste falder sammen med, hvad vi efter Samraad med Sagkyndige anse passende for en Expedition som den af os her omhandlede. Et saadant Skib vilde efter Nylands Verksteds Overslag, med fuld Udrustning, Dampspil, Baade, Høj- og Lavtryks-Maskine af fuld Kraft for Fartøjet, koste 40,000 til 45,000 Spd. efter Nutidens Priser.

B. Den Krigsmarinen tilhørende Skrueskonnert "Alfen", som man havde tænkt at sælge, kunde med en passende Omforandring blive et for Expeditionen hensigtsmæssigt Skib. Naar man forsynede Fartøjet med ny hensigtsmæssigere og større Skrue, en ny større og sterkere Kjedel,

on the part of British *savants*. Of this we have already received assurance. We are also able to state, that the basin of the Arctic Ocean will not be investigated by the "Challenger" Expedition.

The scientific work involved in such an undertaking, would call for the services of a naturalist, with one or two assistants, a physicist, and a chemist. As regards the most fitting season of the year for the cruises of the Expedition, this would be obviously the finest summer months; for in rough weather the greater part of the work of which there can be question is utterly impracticable. Two months and a half — from the middle of June to the end of August — might be reasonably calculated upon, including of course many stormy days on which nothing could be done.

Of all that is needed for the Expedition, the choice of a vessel would be the chief consideration, as her acquisition would involve the greatest outlay. She should be a steamer, with an engine sufficiently powerful to admit of working her in any weather that did not render the exploration of the ocean-depths altogether impracticable; she must, too, be able to take out coals for a considerable period, have an engine specially adapted for economising fuel, be provided with several boats, in which, when occasion called, to put off from the ship, and moreover be manned by a crew sufficiently numerous to do all the work connected with sounding, dredging, trawling, &c, which, being mostly of a laborious character, would require a steam-winch for its effective execution. Finally, there must be room on board for instituting such observations and experiments as admit of being undertaken at sea.

Having made inquiry of persons specially conversant with the subject, we are in a position to state, that, at the present moment, there is no Norwegian steamer that fulfils the conditions specified above. Now, as regards the acquisition of a vessel for the proposed Expedition, choice can be made between three alternatives.

A. The purchase of a new vessel. With respect to this alternative, we are in possession of an estimate, kindly furnished by the Manager of the Nyland Mechanical Works. The said Works have been requested by the Russian Government to give an estimate of the cost of an iron screw-steamer for the Coast Survey of that country, which, as regards burden, tackling, and general equipment corresponds very nearly with the description of vessel that we, having duly consulted experts, believe to be most suitable for the Expedition proposed in this Memorial. Such a steamship, fully equipped, with compound engines, steamwinch, boats, &c., could, as prices now stand, according to the estimate of the Nyland Works, be built for a sum of from Spd. 40,000 to Spd. 45,000.

B. The screw-schooner "Alfen," belonging to the Royal Navy, which was to have been sold, might, by sufficiently extensive alterations, be made a suitable ship for the Expedition. Furnished with a new and improved propeller of increased dimensions, with larger and stronger

formindskede Riggen og foretog Forandringer ved Apteringen, saaledes at der blev Plads for de til Expeditionen hørende Videnskabsmænd og deres Arbejder, foruden til Officierer og Mandskab samt stort Rum til Kul, vilde man faa et Fartøj, som i saadant Vejr, som udfordres til de videnskabelige Arbejder, kunde manøvreres fuldstændigt for Maskinen, og i mere uroligt Vejr kunde manøvreres som Sejlskib, hvorved Betingelserne altsaa vare givne for den størst mulige Kulbesparelse og Kulbeholdningens Forslag for en længere Tid, noget som var nødvendigt for Expeditionens Arbejder ude paa det aabne Hav langt fra Kuldepot. Omkostningerne ved en saadan Forandring er af Nylands Verksted beregnet til 17,000 Spd. Skulde tillige ny Maskine udfordres, hvad der neppe er nødvendigt, vilde Udgifterne stige til henimod 25,000 Spd.

C. Man kunde leje et Dampskib for den Tid, der var nødvendig for Expeditionen hver Sommer, saa længe den varede. Omkostningerne herved er det ikke muligt at opgive, da disse dels ville bero paa Conjuncturerne, dels være afhængige af de Indredninger, som Fartøjet nødvendig maatte gives, for at være skikket til Expeditionsfartøj.

Af disse tre Alternativer er det første det mest anbefalelsesværdige, da det vilde give den største Frihed med Hensyn til det hele Arrangement. I denne Henseende er man noget bundet ved Alternativ *B*, og i højeste Grad ved Alternativ *C*. Ved dette sidste havde man endog den ubehagelige Risico, at maatte foretage nye Foranstaltninger for hver Gang. Expeditionen skulde udrustes, og kunde aldrig gjøre Regning paa hver Gang at faa beholde det samme Skib.

Næst Skibet udfordres der til Expeditionens Øjemed en hel Del Apparater, som Dybvandsliner til forskjelligt Brug (Temperatur, Skrabninger, Strømundersøgelser) Lodder, Patentblokke, Accumulatorer, Thermometre, Skraber, Net, fysiske (magnetiske) Apparater, Glas, Spiritus m. m. Efter velvillig Opgave af Capt. Davis af det Britiske Admiralitets hydrografiske Afdeling vil man kunne udruste et mindre Skib med de for Dybvandsundersøgelser nødvendige Apparater for en Sum af 1,000 til 1,200 Lstrl. eller 4,500 til 5,400 Spd.

Omkostningerne ved at holde Expeditionen ude, nemlig Hyre, Kost, Kul, Vedligeholdelse m. m. ere af Capitainlieutenant C. Petersen, der velvillig har bistaaet os ved Udarbeidelsen af disse Overslag, beregnede til 2000 Spd. pr. Maaned. Dette giver for en Tid af $2^1/_2$ Maaned en Sum af 5000 Spd. aarlig.

Hvormange Sommere, der ville medgaa, førend Expeditionens hele Øjemed var naaet, er det ikke muligt paa Forhaand at sige. Det kommer her saa meget an paa hvilke Forhold man ved Undersøgelserne finder og hvorledes Vejret arter sig. Vi tro dog, at man i 2 meget gun-

boilers, less heavily sparred, and fitted up below deck in such manner as to afford room alike for the personal accomodation of the members of the Expedition, and for such part of their work as could be done on board, as also for the officers and crew, together with stowage for coal, the "Alfen" would be a vessel which, in weather admitting of the scientific exploration of the ocean, might be worked as a steamer, and, in a heavier sea, as a sailing-ship, thus securing the conditions requisite for the greatest possible economy in the consumption of fuel, and for adjusting the stock of coal to the length of the period during which the Expedition would have to cruise in the open sea, far from any coaling-station. The cost of such alterations has been estimated by the Manager of the Nyland Works at Spd. 17,000. New engines — which however will hardly be wanted — would raise the outlay to about Spd. 25,000.

C. A steamer might be chartered every summer for the period over which the cruise of the Expedition would extend. As regards the cost, nothing definite can be stated, since the amount must depend partly on the state of the freight-market, and partly on the expense entailed by adapting the vessel to the requirements of the Expedition.

Of these three alternatives, the first is, in our judgment, the most desirable, admitting as it does of greater freedom in the general arrangement. The character of the second alternative, *B*, would, to some extent, be found restrictive in its operation; but the third alternative, *C*, might, if selected, lead to serious inconvenience and uncertainty, involving as it would the risk of new arrangements having to be made for each successive cruise, since the Expedition could hardly rely on being able to retain during the whole period of its duration the vessel originally chosen.

Next in importance to the ship, are the apparatus and appliances of various kinds with which the Expedition would have to be furnished, such as deep-sea lines for divers purposes (temperature, dredging, investigation of currents), sounding-leads, patent blocks, accumulators, thermometers, dredges, nets, physical (magnetical) instruments, glass jars, tubes, &c., and spirits of wine, &c., &c. According to a statement kindly furnished by Captain Davis of the Hydrographic Department of the British Admiralty, a vessel of moderate size might be fitted out with the instruments and apparatus necessary for such an Expedition at a cost of from 1000*l.* to 1200*l.* (Spd. 4500—5400).

As regards the current expenses of the Expedition, viz. for seamen's wages, rations, coal, wear and tear of vessel, &c. &c., these are put by Commander C. Petersen, R. N., who has kindly assisted in furnishing the above estimates, at Spd. 2000 a month. Hence, according to this calculation, the cost of a $2^1/_2$ months' cruise would be Spd. 5000.

How many summers would elapse ere the object of the Expedition had been fully attained, it is of course impossible to state beforehand, so much must necessarily depend on the proportions the investigation would assume, and on the weather. Meanwhile, your memorialists are of

stige eller 3 rimelige Sommere vil kunne have erhvervet et antageligt Udbytte fra den hele Havstrækning, hvorom her er Tale.

Af de til Dybvandsundersøgelserne hørende Apparater er der flere som maa fornyes hvert Aar. Efter Expeditionens Slutning bliver der dernæst Spørgsmaal om Midler til Resultaternes videnskabelige Bearbejdelse og deres Publication. Thi først naar denne foreligger, kan Foretagendet siges at være afsluttet. De hertil udfordrende Summer kunne vi ikke give noget Overslag over; de bero paa det Udbytte, som Expeditionen i Havet kan yde.

Vi have fremsat vore Anskuelser om Vigtigheden af en Undersøgelsesexpedition til Havet udenfor Norges Vestkyst og om Maaden, hvorpaa den kan udføres, i den Overbevisning, at denne Sags Fremme vil være et Foretagende, som vil bidrage mere end noget andet til at hævde vort Land den Plads i den videnskabelige Verden, som dets Beliggenhed og Naturforhold har anvist det, og som vil give de mest tilfredsstillende Oplysninger om Spørgsmaal, der vedrøre vort Lands materielle Velvære i mange Retninger. At et saadant Foretagende er forbundet med større Omkostninger, der dog ikke kunne ansees betydelige i Forhold til det forventede Udbytte, har ikke kunnet holde os tilbage fra at foreslaa Udførelsen af et Verk, som vi maa anse for at være i Fædrelandets højeste Interesse.

Vi tillade os derfor ærbødigst at henstille til det kongelige Departement at søge bevirket de nødvendige Pengemidler bevilgede til Udførelsen af en naturvidenskabelig Undersøgelsesexpedition til Havet mellem Norge, Færøerne, Island, Jan Mayen og Spidsbergen.

Christiania den 19de Marts 1874.

H. Mohn. **G. O. Sars.**

Over dette Forslag afæskede Departementet Betænkninger fra Directionen for den geografiske Opmaaling, det mathematisk-naturvidenskabelige Facultet ved Universitetet i Christiania, Børskomiteerne i Kristianssand, Bergen og Throndhjem, Opsynscheferne ved Vaarsildfiskeriet og ved Lofotfiskeriet, samt fra Directionen for Bergens Museum, ligesom det ogsaa henstillede til Marine-Departementet at udtale sig i Sagen, navnlig om Anskaffelse af Skib og om hvilken Myndighed dettes Udrustning og Bestyrelse burde bevirkes overdraget. Samtlige disse Autoriteter udtalte sig

opinion that in 2 exceptionally favourable or in 3 average summer-seasons, the whole of the ocean-tract here referred to might be satisfactorily explored.

Several of the instruments and appliances would have to be renewed each cruise. At the close of the Expedition a further grant of money would be needed, for working up and publishing the results. The amount thus required to terminate the undertaking, we are not in a position to name, since it must obviously be proportioned to the general success of the Expedition.

We have set forth in this Memorial our views touching the great importance of an Expedition having for its object the exploration of the ocean-tract lying off the West Coast of Norway, and also as to the means for achieving it, — in the firm conviction that such an undertaking would contribute above any other to insure our country that rank among civilised nations which by reason of her geographical position and physical conditions she is entitled to hold; and moreover, that it must help to throw light on many intricate subjects closely connected with her material prosperity. That the projected Expedition will involve an outlay considerable indeed if not great compared with its probable results, has therefore failed to deter your memorialists from advocating the claims of an undertaking the speedy realisation of which they cannot but regard as a question profoundly affecting the interests of our country.

We venture therefore to hope, that the Home Department of His Majesty's Government will take the necessary steps to obtain a grant of money sufficient to defray the cost of an Expedition having for its object the scientific exploration of the ocean-tract stretching between Norway, the Færoe Islands, Iceland, Jan Mayen, and Spitzbergen.

Christiania, March 19th. 1874.

H. Mohn. **G. O. Sars.**

Touching this proposal, the Home Department advised with the Directors of the Geograpical Survey, the Faculty of Sciences of the University of Christiania, the Exchange-Committees in Christiansand, Bergen, and Throndhjem, the Government Inspectors of the Spring Herring Fishery and of the Lofoten Cod Fishery, and with the Directors of the Bergen Museum; moreover, the Navy Department was also desired to pass opinion on the subject, more particularly as to how a suitable vessel might be procured, and what official body should have charge of the

for Expeditionens Istandbringelse og tiltraadte i det Væsentlige de af Forslagsstillerne udtalte Anskuelser.

Da Departementet for det Indre var enig i Marine-Departementets Udtalelse, at Expeditionens Bestyrelse eventuelt burde underlægges Directionen for den geografiske Opmaaling, anmodedes denne under 15de October 1874 om at indkomme med detaljeret Overslag over de Omkostninger, som Expeditionen vilde udkræve. Dette Overslag indsendte Direktionen under 8de Marts 1875, og under 23de samme Maaned indgik Regjeringen med underdanigst Instilling i Sagens Anledning. Da samtlige indhentede Betænkninger gik ud paa, at det vilde være hensigstmæssigst, at der blev bygget et til Expeditionen særlig indrettet Fartøj, og da Directionen i sit ovennævnte Overslag ogsaa satte dette som første Alternativ, optoges det i Indstillingen, idet Departementet underdanigst androg om, at der for Storthinget maatte blive fremsat naadigst Proposition om Bevilgning af en Sum af 61,500 Spd. (246,000 Kroner) til Anskaffelse af Skib med Rig, af Instrumenter og Inventarium samt til forberedende Arbejder. Denne Indstilling blev bifaldt ved kongelig Resolution af 30te Marts 1875.

Den 20de og 21de Maj behandledes Sagen i Storthinget, hvis Beslutning gik ud paa, at Expeditionen skulde udføres med lejet Fartøj, idet følgende af Repræsentanten Haugland fremsatte Forslag vandt de fleste Stemmer:

"Til Anskaffelse af Apparater, Instrumenter m. V. samt til første Aars Drift af en videnskabelig Expedition til Undersøgelse af den Del af Atlanterhavet, der omsluttes af Norge, Færøerne, Island, Jan Mayen og Spidsbergen, bevilges for Budgetaaret fra 1ste Juli 1875 til 30te Juni 1876 indtil 20,000 Spd."

Da Expeditionens Udførelse saaledes var besluttet, blev Kaptein i Marinen *C. Wille,* der i en Række Aar havde ledet Dyblodningerne udenfor Norges Kyst som Chef for Oplodningsdampskibet "Hansteen", og som havde assisteret Opmaalingsdirectionen ved Udarbeidelsen af det ovennævnte Overslag over Expeditionens Kostende, af Departementet for det Indre overdraget Forberedelserne til dens Udrustning, hvilke tog sin Begyndelse 10 Dage efter at Storthingets Beslutning var faldt, med at Capt. Wille rejste til England, dels for at konferere med Chefen for "Challenger,". Capt. Nares, der om kort Tid skulde afgaa med den Britiske Polar-Expedition, dels for at gjøre de forberedende Skridt til Anskaffelse af Apparater og Instrumenter.

Opmaalingsdirectionen foranstaltede derefter udstedt Indbydelse i de offentlige Blade saavel her i Riget som i Sverige til Anbud paa Bortleje af Fartøj. Der indkom Tilbud fra Rederierne for 11 Dampskibe, blandt hvilke

the same and superintend her equipment. The aforesaid authorities were unanimous in favour of the Expedition, and shared in the main the views set forth by the proposers in their Memorial.

The Department for Home Affairs agreeing with the Navy Department that the general management of the Expedition should devolve on the Directors of the Geographical Survey, the latter were desired, in a communication bearing date October the 15th, 1874, to prepare a statement of the probable outlay which such an Expedition would involve. On March the 8th, 1875, the Directors sent in their estimate, and on the 23rd of the same month His Majesty's Government brought the subject before the Privy Council in a formal proposition. The several declaratory statements from the above-mentioned authorities being to the effect, that it would be best to have a vessel built specially adapted for the Expedition, and the Directors of the Geograpical Survey having in their estimate also pronounced in favour of that alternative, it was advocated in the Government proposition, the Home Department most respectfully submitting, that application should be made to the Storthing for a grant of Spd. 61,500 (Kr. 246,000), to defray the cost of a fully equipped vessel, including instruments and preliminary expenses. This proposition was approved by an Order in Council, bearing date March the 30th, 1875.

On the 20th and 21st of May, the subject was deliberated in the Storthing, the issue of the debate being that a vessel should be chartered for the Expedition, the House declaring in favour of the following motion, brought forward by the representative Haugland: —

"For the purchase of instruments, apparatus, &c., and for defraying the current expenses of the first year's cruise of a Scientific Expedition to the tract of ocean stretching between Norway, the Færoe Islands, Iceland, Jan Mayen, and Spitzbergen, the Storthing doth hereby grant for the financial year commencing July the 1st, 1875, and terminating July the 1st, 1877, a sum not exceeding Spd. 20,000 (4,444 *l.*)

The State having accordingly resolved to despatch an Expedition, Captain *C. Wille,* R. N., who, as commander of the "Hansteen," a steamer built for the Norwegian coast survey, had been engaged in conducting deep-sea soundings off the coast, and who had assisted the Directors of the Geographical Survey when preparing their estimate of the cost of the Expedition, — was appointed by the Home Department to take the preparatory steps for fitting her out; and two days after the assent of the Storthing had been given, Capt. Wille left for England, partly that he might there confer with the captain of the "Challenger," G. S. Nares, who was shortly to set out on the British Polar Expedition, partly to arrange for the purchase of apparatus, instruments, &c.

Soon after Capt. Wille's departure, the Directors of the Geographical Survey invited ship-owners, both in this country and in Sweden, by advertisements in the public journals, to make offer of a vessel for the Expedition. The number

et svensk. Ved kongelig Resolution af 23de December 1875 blev Dampskibet "Vøringen" af Bergen antaget, da det ansaaes i det Hele hensigtsmæssigt og solid, da Rederiet strax havde gjort det billigste Tilbud og ligeledes gik ind paa de Fordringer, der stilledes angaaende Rig og Indredning.

Den af Departementet med Rederiet afsluttede Kontrakt, der i det væsentlige ligelydende fornyedes for hvert af de to følgende Aar 1877 og 1878 (med Undtagelse af at Lejen forhøjedes til 1,100 Spd. pr. Maaned) var saalydende:

"Rederiet bortforpagter herved Dampskibet "Vøringen" til Brug for Atlanterhavs-Expeditionen og leverer Skibet i Bergen omkring den 15de April, saafremt ikke Havari derfor er til Hinder. I dette Tilfælde skal Rederiet, saa snart ske kan, indsende Underretning til Departementet. Dersom Expeditionens Chef ikke anser det rimeligt, at Skibet vil kunne leveres senest de første Dage af Maj, er han berettiget til at anse nærværende Kontrakt som hævet. Skibet afleveres igjen i Slutningen af August eller Begyndelsen af September, saafremt intet uforudseet Tilfælde indtræffer.

Skibet leveres hægt og tæt, doksat, rengjort og malet, Maskinen efterseet og i fuld Orden, udstyret med Topsejl paa begge Master og dertil hørende Rig, samt forsynet med tilstrækkelig Ballast.

Rederiet tillader Skibets Indredning og Udbedring igjen efter endt Togt, overensstemmende med de af Hrr. Brunchorst & Dekke leverede Planer.

Det kongelige Departement vedtager at have befragtet "Vøringen" for ovennævnte Tidsrum paa ovennævnte Betingelser, samt at betale i Fragt 1000 Spd. pr. Maaned fra den Dag, Skibet afleveres til Indredningens Paabegyndelse, indtil det igjen tilbageleveres i Bergen i ryddiggjort og udbedret Stand. Maaneden regnes fra Dato til Dato og for overskydende Dage regnes 33 Spd. 40 Skill. pr. Dag. Betalingen erlægges ved hver Befragtningsmaaneds Udløb.

Skibet gaar for Rederiets Risico. Som Følge heraf ophører Lejen i Tilfælde af totalt Forlis eller af saadant Havari, hvis Reparation af Expeditionens Chef antages at ville medtage saa lang Tid, at Expeditionen ikke mere med Nytte kan fortsættes det Aar.

Ved totalt Forlis ophører Lejen strax. Er totalt Forlis ikke bevisligt, men Fartøjet udebliver, betales Lejen vedvarende, dog ikke længere end 10 Uger fra den Tid, da seneste Efterretninger indløb.

I Tilfælde af saadant Havari, som nævnt, har Expeditionens Chef, naar han kommer i Havn, derom at underrette Rederiet, med Opfordring til dette om ufortøvet at modtage Fartøjet. Leje betales i dette Tilfælde i en Maaned fra den Dag, Underretningen er givet, dog under

of tenders received was 11, one from Swedish owners. An Order in Council, bearing date December the 23rd, 1875, confirmed the selection of the steamship "Vøringen," of Bergen, a vessel strongly built, and, on the whole, well adapted for the requirements of the Expedition; moreover, her owners, whose offer was the lowest, had at once agreed to the stipulated conditions respecting equipment, &c.

The Contract between the Home Department and the owners of the "Vøringen," which, with the exception of a clause raising the hire to Spd. 1100 per month, was renewed in the same form for each of the following cruises (in 1877 and 1878), ran as follows: —

"The owners of the S. S. "Vøringen" do hereby agree to let that vessel for the use of the North-Atlantic Expedition, and undertake to deliver her in the port af Bergen on, or about, the 15th of April, unless she have sustained damage, in which case her owners shall forthwith send notice to the Home Department. Should the Naval Director of the Expedition feel convinced that the vessel cannot be got ready by the first week in May, he shall be at liberty to cancel this Contract. The vessel to be given up to the owners at the end of August, or the beginning of September, no unforseen event intervening.

"The vessel to be delivered in warrantable condition, docked, careened, and painted, with her engines examined and in perfect working order; moreover, she shall be rigged with a top-sail to each mast, and have sufficient ballast.

"The owners agree to the ship being fitted up and repaired at the end of the cruise conformably to the plans furnished by Messrs. Brunchorst and Dekke.

"The Home Department of His Majesty's Government doth hereby acknowledge to have chartered the S. S. "Vøringen" for the aforesaid term and on the aforesaid conditions, at the rate of Spd. 1000 per month, from the day on which the ship is delivered in Bergen to the deputed agent of the Government to the day on which she is given up, put in order and repaired, to the owners in Bergen. For every day over and above a full calender month shall be paid 33 Spd. 40 Skill. The freight to fall due at the expiration of each month of the term for which the vessel is chartered.

"The ship to sail at the owners' risk. Hence all payment of freight shall cease in the event of total loss, or of the vessel sustaining such damage that the repairs thereby entailed, in the opinion of the Naval Director of the Expedition, cannot be completed sufficiently soon to admit of continuing the cruise with advantage.

"Total loss cancels the contract at once. But should total loss not admit of proof, from the absence of the vessel, the freight shall continue to be paid, though not for longer than 10 weeks from the date at which intelligence of the vessel was last received.

"In the event of the ship sustaining damage as aforesaid, the Naval Director of the Expedition shall, on his arrival in port, communicate with the owners, desiring them to take charge of the vessel forthwith. In such case the liability for freight to extend one calender month from the

ingen Omstændigheder længere end til 7dé September."

Ved kongelig Resolution af 5te Februar 1876 blev det overdraget følgende Videnskabsmænd at deltage i Expeditionen: Professor i Meteorologien *H. Mohn,* Professor i Zoologi *G. O. Sars,* Overlæge ved Lungegaardshospitalet i Bergen Dr. med. *D. C. Danielssen,* Kjøbmand i Bergen *Herman Friele* og Stud. real. *S. M. Svendsen.* Som Chef for Expeditionens Skib antoges ved samme Resolution Captein *C. Wille,* der tillige skulde overtage Udførelsen af de videnskabelige Iagttagelser, som vare forudsatte fremmede ved Expeditionen og som ikke specielt maatte gaa ind under nogen af de øvrige ved Expeditionen ansatte Videnskabsmænds Omraade. Som Tegner blev senere antaget Landskabsmaler *F. Schiertz.*

Efter Opmaalingsdirectionens Foranstaltning besørgede Capt. Wille Anskaffelsen af de til Expeditionen fornødne Instrumenter og Apparater samt Skibets Indredning og Udrustning.

For Expeditionens videnskabelige Medlemmer blev givet af Opmaalingsdirectionen følgende af Departementet for det Indre approberede Instrux, der var gjældende for hvert af de tre Aar 1876, 1877 og 1878.

§ 1.

Den for Expeditionen approberede Plan søges udført, saavidt Vejrforhold eller andre uforudseede Omstændigheder ikke er ivejen derfor. Afgjørelsen af hvorvidt Vejrforhold eller Skibets Tilstand maatte træde hindrende ivejen, tilligger Fartøjets Chef.

§ 2.

Planens Udførelse i det enkelte sker efter Samraad og Afstemning af Expeditionens videnskabelige Medlemmer, til hvilke ogsaa Fartøjets Chef hører.

Afgjørelsen sker efter simpel Pluralitet.

De videnskabelige Medlemmer vælge sig imellem en Formand, hvis Stemme i Tilfælde af Stemmelighed gjør Udslaget.

§ 3.

Skulde den under Rejsen gjorte Erfaring gjøre det sandsynligt, at Afvigelser fra den lagte Plan i højere Grad vilde ramme Expeditionens Formaal, kunne saadanne foretages, naar samtlige videnskabelige Medlemmer derom ere enige.

§ 4.

Chefen for Expeditionsskibet har at sørge for, at dette er hensigtsmæssigt udrustet og forsynet med de for Expeditionens Øjemed nødvendige Apparater, samt at de Rejser og Manøvrer blive udførte, der udfordres til Opnaaelse af Expeditionens Formaal.

§ 5.

Naar Havn anløbes meddeler Skibschefen Bestyrelsen fornøden Underretning om Expeditionens Fremgang, ligesom han ogsaa aflægger samlet Rapport efter endt Togt. Efter Expeditionens Afslutning indsendes fra dens viden-

day on which the intelligence was received, but not longer than the 7th of September."

By an Order in Council, bearing date February the 5th, 1876, the following gentlemen were appointed members of the Scientific Staff: — *H. Mohn,* Professor of Meteorology; *G. O. Sars,* Professor of Zoology; *D. C. Danielssen,* M. D., physician to Lungegaard's Hospital in Bergen; *Herman Friele Esq.,* merchant in the city of Bergen; and *S. M. Svendsen,* undergraduate of the University of Christiania. By the same Order, Capt. *C. Wille,* R. N., was appointed to command the vessel chartered for the Expedition, and to institute such scientific observations as there would, it was believed, be found facilities for taking, but which did not strictly come within the province of any member of the Civilian Scientific Staff. Subsequently, the services of *F. Schiertz,* artist, were also engaged.

At the instance of the Directors of the Geographical Survey, Capt. Wille procured for the Expedition the necessary instruments and apparatus, and superintended the general fitting-out of the vessel.

For the guidance of the Scientific Staff on board, the Directors of the Geographical Survey, with the sanction of the Home Department, issued the following Instructions, which remained in force on the three cruises of the Expedition, in 1876, 1877, and 1878.

§ 1.

The Scheme approved for the Expedition shall be strictly adhered to, unless bad weather, or some unforseen interfering cause, prevent its being carried out. It rests with the Captain to pronounce on the state of the weather and of the ship.

§ 2.

Previous to execution, all the details of the Scheme shall be discussed and put to the vote by the Scientific Staff on board, of which the Captain of the vessel is a member.

The decision of the majority to be final.

The Scientific Staff shall from among their number elect a chairman, who has the casting vote.

§ 3.

If, during the progress of the cruise, very considerable deviation from the Scheme approved for the Expedition be found advisable, such deviation is permitted, all the members of the Scientific Staff consenting thereto.

§ 4.

On the Captain of the vessel shall devolve the duty of fitting her out, and of furnishing her with the necessary apparatus, as also of navigating and working her in a manner calculated to attain the object of the Expedition.

§ 5.

From every port at which the vessel may touch, the Captain shall advise the Directors of the Geographical Survey of the progress of the Expedition; and after his return he has to report generally on the cruise. The Expedition

skabelige Medlemmer en Generalberetning til Bestyrelsen.

§ 6.

De Samlinger af videnskabelige Iagttagelser og Naturalier, som Expeditionen tilvejebringer, forblive denne tilhørende, indtil de efter Bestemmelse af Expeditionens videnskabelige Medlemmer ere bearbejdede. Publikationen af de gjorte Iagttagelser samt deres Resultater og Fordelingen af de indsamlede Naturalier bestemmes af Bestyrelsen efter Forslag af de videnskabelige Medlemmer.

For hvert Aars Togt udarbejdedes af Expeditionens Medlemmer i Forbindelse med Opmaalingsdirectionen (General Grimsgaard, Fyrdirektør Diriks og Professor Mohn) en Arbejdsplan, der indsendtes til Departementet for det Indre til Approbation.

1876.

Den for dette Aar approberede Plan var følgende:

Saasnart Expeditionsfartøjet i Bergen har modtaget sin fulde Udrustning og de Instrumenter og Apparater, der skulle have sin Plads ombord, ere anbragte, kunne de Iagttagelser begynde, der ere nødvendige for Bestemmelsen af de forskjellige magnetiske Constanter ved Skibet og de respective Instrumenter.

Da saadanne Iagttagelser bør foretages paa et Sted, der er saavidt muligt frit for den saakaldte magnetiske Localattraction, og da Erfaringen fra "Hansteens" Togt i 1875 har vist, at man ikke kan gjøre Regning paa at blive fri for denne Virkning, førend man kommer ud paa de yderste Øer og Skjær paa Kysten, ville de nævnte Iagttagelser ikke kunne udføres med Fordel i Bergen.

Af Resultaterne af "Hansteens" Togt i 1875 fremgaar det, at Øerne Utvær, og navnlig Husø ved Sognefjordens Munding har den forønskede Frihed for Localattraction. Paa dette Sted ville derfor de forberedende magnetiske Iagttagelser antagelig bedst blive at udføre. Hvor lang Tid disse Iagttagelser ville tage, beror paa Vejrforholdene, navnlig fordi der til enkelte af dem kræves Sol til en bestemt Dagstid.

Da en Flerhed af de Instrumenter og Apparater, hvormed Expeditionen vil have at arbejde, paa denne komme til Anvendelse under Forhold, der paa Grund af Foretagendets større Maalestok og Udrustningens større Fuldstændighed ere Expeditionens Deltagere delvis nye, og da Mandskabet trænger til Opøvelse i de for de videnskabelige Operationer nødvendige Manøvrer, ansees det for mest hensigtsmæssigt og i Længden mest tidsbesparende at foretage foreløbige Forsøg til Øvelse med samtlige de under Expeditionen benyttende Apparater.

En udmerket Lejlighed til den første Prøve, der tillader Operationerne at foregaa i smult Vand paa samme

ended, the members of the Scientific Staff shall send in a General Report to the Managing Committee.

§ 6.

The observations instituted and natural objects collected shall belong to the Expedition till such time as, with the approbation of the Scientific Staff, they have been duly worked out and described. The publication of the observations and their results, and the distribution of the natural objects, to devolve on the Directors of the Geographical Survey, and to be in accordance with the proposition of the Scientific Staff.

For each cruise the members of the Scientific Staff, in conjunction with the Directors of the Geographical Survey (General Grimsgaard, F. Diriks, Director of Lighthouses, and Professor Mohn), drew up a Scheme of Work, which was laid before the Home Department for approval.

1876.

The Scheme approved for this year was as follows: —

When the vessel selected for the Expedition, now lying in the port of Bergen, has been fully equipped, and the instruments and apparatus with which she is to be furnished have been arranged on board, the observations necessary to determine the magnetic constants for the ship and the respective instruments may forthwith commence.

As such observations should be taken in a spot as nearly as possible free from the so-called magnetic local attraction, and the cruise of the "Hansteen" in 1875 having shown that this disturbing influence does not cease to be felt at a less distance from the coast than the outermost islands and skerries, the said observations cannot give satisfactory results if made in Bergen.

From observations instituted on the cruise of the "Hansteen" in 1875, it appears that the islands of Utvær, and more especially the island of Husø at the entrance to the Sognefjord, are well nigh uninfluenced by local attraction. On the latter island, therefore, it will be best to undertake the preliminary magnetic observations. What time will be required to complete these observations, must depend on the state of the weather, particularly since sunshine at a certain hour of the day is indispensable for some of them.

As very many of the instruments and appliances necessary for the Expedition, will have to be used under conditions which, by reason of the comparatively extensive scale whereon the Expedition has been planned, and the relative completeness of equipment, are in several respects new to the members of the Expedition; and the crew needing practice for the work connected with the scientific operations, it is deemed advisable, and will in the long run be the surest means of saving time, to make preliminary excursions, or trial-trips, with a view to acquire experience in handling the apparatus.

An excellent locality to begin with, that would admit of carrying on the operations both in smooth water and

Tid som den Dybde, paa hvilken der kan opereres, er betydelig, frembyder Sognefjorden, der i sin ydre Del, udenfor Ladvik, er over 660 Favne dyb.

Til Udførelsen af den Plan, i denne Del af Sognefjorden at foretage de første forløbige Arbejder, knytter sig den Interesse, som Undersøgelsen af Forholdene i Sognefjorden har, navnlig i zoologisk Henseende, i hvilken Retning Fjorden endnu er meget lidet undersøgt. Som bekjendt danner Sognefjorden ved sin ringe Dybde i Mundingen et fra Havet temmelig afsluttet Dybbassin.

Da der mellem det paapegede Punkt af Sognefjorden og Utvær kun er liden Afstand, vil man, naar Vejrforholdene falde ugunstige for de magnetiske Observationer paa dette Sted, med Lethed kunne benytte Tiden til Øvelserne i Sognefjorden og saaledes kunne gjøre Regning paa at faa begge disse forberedende Arbejder udførte i en rimelig Tid.

Efterat man saaledes har vundet det fornødne Kjendskab til Apparaterne og Øvelse i Brugen af dem i smult Vand, kræves, at man vinder Erfaring i deres Anvendelse paa Søen, i mindre roligt Vejr. De hertil fornødne Øvelser antages at kunne, paa den mest frugtbringende Maade, forenes med Udførelsen af Expeditionens egentlige Øjemed, ved følgende Ordning af Arbejdet.

Den dybe Rende, der ligger udenfor den norske Kyst fra Skagerak til Stat, fjerner sig her fra Kysten og synes at udmunde i Ishavsdybet. Der foreligger imidlertid Temperaturiagttagelser, der tyde hen paa Muligheden af, at Renden grunder op eller lukker sig. Undersøgelsen af dette Punkt vil derfor udgjøre en passende Gjenstand for Expeditionens Begyndelsesarbejder. Ved at følge Rendens Bund fra Sognefjorden af nordover og undersøge dens Forhold udenfor Stat og Romsdalskysten har man Fordelen af at være paa Søen i et Farvand, hvor Naturforholdene tilstede Apparaternes Anvendelse i forskjellige Retninger og hvor Undersøgelsernes Resultater ville blive baade instructive for Iagttagerne og oplysende for Videnskaben, og hvor man ikke er længere fra Land, end at man med Lethed vil kunne søge dette, for at iverksætte mulige Udbedringer eller ønskelige Forbedringer af Apparaterne, som Erfaring maatte vise det hensigtsmæssigt at foretage, førend man tiltræder Rejsen til fjernere Egne.

Efterat man saaledes havde vundet Erfaring i Søen og faaet undersøgt det Parti af de norske Kystbanker, hvorpaa Expeditionens videre Undersøgelser maa støtte sig, maatte man, forat komplettere Udrustningen for et længere Togt, anløbe en større Havn, f. Ex. Kristiansund. Her skulde Fartøjet blive at forsyne med komplet Udrustning af Kul og Vand, Kronometernes Stand og Gang bestemmes og mulige Udbedringer ved Apparaterne foretages.

Naar Expeditionen saaledes er i fuldt udrustet Stand (antagelig omkring St. Hanstider), kunne dens Arbejder

at a considerable depth, is the Sognefjord, which in its outer part, off Ladvik, is 660 fathoms deep.

Moreover, the selection of the Sognefjord as the tract wherein to commence the preliminary work of the Expedition, would afford a desirable opportunity of scientifically exploring that region, which has hitherto been but little investigated, in particular as regards its fauna. The Sognefjord constitutes, by reason of remarkable shallowness at its mouth, a deep basin well nigh cut off from the ocean without.

The distance between the above-mentioned point of the Sognefjord and Utvær being comparatively short, when the weather did not admit of continuing the magnetic observations in the latter locality, the time might be advantageously employed in the Sognefjord, and there would thus be a fair prospect of completing both parts of the preliminary work within a reasonable period.

Knowledge of the apparatus, and the requisite familiarity with their use in smooth water, having been thus attained, the next step will be to acquire experience of their application at sea in comparatively rough weather. The practice necessary for this purpose may, it is believed, be easily combined with the main object of the Expedition by conducting the work as follows: —

The deep channel extending along the shores of Norway from the Skagerak to Stat, leaves the coast in this locality, and would appear to disembogue into the depths of the Arctic Ocean. Perhaps, however, inferring from certain temperature-observations, the channel gradually shoals or closes. The clearing up of this question will form a fitting subject for the opening work of the Expedition. By following the channel from the Sognefjord northwards, and investigating its conditions off Stat and the coast of Romsdalen, the Expedition will secure the advantage of cruising in a tract of ocean which admits of a manifold use of the apparatus, and where the results of the investigation must prove alike instructive to the observers themselves and specially promotive of the interests of science; moreover, the distance from land being comparatively short, it will, if necessary, be easy to run in shore, for the purpose of repairing the apparatus, in case of accident, or of effecting such alterations in their construction as may be found desirable, before proceeding to more distant regions.

Having thus acquired experience in the use of the apparatus at sea, and investigated that portion of the Norwegian coastal banks on which the Expedition must base its subsequent operations, it will be necessary to touch at one of the larger ports, for instance Christiansund, and there complete the equipment of the vessel, — viz. by taking in a full supply of coal and water, examining the chronometers, repairing, if damaged, the apparatus, and effecting any improvements in their construction that experience may suggest.

Then, — so soon as the vessel shall in such wise have been fully equipped for the cruise (about the end of June), the work

fortsættes med Afslutningen af Undersøgelserne af Bankerne udenfor Romdalskysten henimod Shetland.

Fra dette Felt kommer man videre vestover til den dybe Rende mellem Shetland og Færøerne, der, navnlig i dens sydvestre Del, har været Gjenstand for "Porcupine"-Expeditionens Undersøgelser. Dens nordøstre Del vil det blive den norske Expeditions Opgave at undersøge nærmere og studere dens Overgang til det kolde Ishavsdyb. Paa denne Strækning ville Iagttagelser af Strømforholdene samt Undersøgelse af Havvandets Beskaffenhed i de forskjellige Dybder, til hvilke Forholds Undersøgelse den norske Expedition antagelig vil være bedre udrustet end den nævnte Britiske, kunne blive af fundamental Betydning for Havstrømmenes Theori.

En Betingelse for Held er imidlertid roligt Vejr.

Efter Afslutningen af Undersøgelsen af Færø-Shetland Renden, vil det af flere Grunde, der nedenfor ere nævnte, være hensigtsmæssigt, at man anløber Thorshavn paa Færøerne, for at forberede sig til Undersøgelsen af Strækningen mellem Færøerne og Island.

Undersøgelserne paa denne Strækning ville omfatte Forholdene ved Overgangen fra det forholdsvis grunde Hav mellem Færøerne og Island, der endnu tilhører Atlanterhavet, til det kolde Ishavsdyb, der ligger østenfor. Her kommer Expeditionen til at arbejde paa et saagodtsom i alle Henseender aldeles nyt Felt, hvad der ogsaa gjælder de følgende Strækninger.

Paa Island er det nødvendigt at foretage lignende magnetiske Iagttagelser som dem, der ere tænkte udførte paa Utvær. Antagelig vil Reykjaviks Havn i denne Henseende frembyde en bekvem Lejlighed.

Mellem Kap Farvel og Island er der i sidste Sommer af Chefen for den britiske Fregat "Valorous," Captein Jones, udført en Række Iagttagelser af Dybtemperatur i Forbindelse med Bundskrabninger. Denne Række udfylder paa en efter Omstændighederne tilfredsstillende Maade Overgangen mellem de tidligere undersøgte Dele af Atlanterhavet og den Linie, der — som dannende Overgangen fra Atlanterhavet til vort arktiske Havbassin — maa blive at sætte som den vestlige Grændse for den norske Expeditions Undersøgelsesfelt, nemlig Linien gjennem de Stræder og Havstrækninger, der adskille Shetlandsøerne, Færøerne, Island og Grønland.

For at fuldstændiggjøre Undersøgelserne paa denne Linie bliver det den norske Expeditions Opgave at forsøge undersøgt Strækningen mellem Island og Grønland, en Opgave, hvis Løsnings Vigtighed Dr. Carpenter, en af Deltagerne og Lederne af flere af de britiske Dybhavsexpeditioner, med Styrke har gjort opmerksom paa.

of the Expedition can be continued, by closing the investigation of the banks off the coast of Romsdalen in the direction of the Shetland Islands.

Westwards from this tract extends the deep channel between the Shetlands and the Færoe Islands, which — in particular its south-westerly portion — was explored on the "Porcupine" Expedition. The north-eastern part, together with the how and where this channel passes into the depths of the Arctic Ocean, will be made a subject of special investigation by the Norwegian Expedition. Observations on the direction and rate of the currents throughout this section of the channel, and on the chemical constituents of the water at different depths, which the Norwegian Expedition, from the character of its equipment, will, it is believed, have greater facilities for instituting than had the above-mentioned British Expedition with the "Porcupine," may prove of fundamental importance in elucidating the theory of ocean currents.

Meanwhile, a *sine quâ non* for achieving success is favourable weather.

After terminating the investigation of the Færoe-Shetland channel, it will, for divers reasons, specified below, be advisable to touch at Thorshavn on the Færoe Islands, previous to exploring the ocean-tract between the Færoe Islands and Iceland.

In this locality, the Expedition will investigate the nature of the transition from the comparatively shallow sea (part of the Atlantic) between the Færoe Islands and Iceland to the depths of the Arctic Ocean, stretching eastwards. Here, the exploratory work will be in a field essentially new, which also applies to the succeeding tracts.

In Iceland, magnetical observations must be instituted similar to those the Expedition will take at Utvær. For this purpose, the port of Reykjavik is believed to be a convenient locality.

Last summer a series of deep-sea temperatures, in connexion with dredgings, were taken by Loftus Jones, captain of the British frigate "Valorous," between Cape Farewell and Ireland. These observations have, as far as circumstances would permit, contributed greatly to our knowledge of the part of the Ocean lying between the sections of the Atlantic previously investigated and the line which — constituting as it does the boundary between the Atlantic and the basin of the Arctic Ocean — must be regarded as the western limit of the region it is the object of the Norwegian Expedition to explore, viz. the line passing through the straits and tracts of ocean that extend between the Shetlands, the Færoe Islands, Iceland, and Greenland.

With a view to render the investigation along this boundary-line as complete as possible, the Norwegian Expedition will endeavour to explore the tract between Iceland and Greenland, — a problem to the importance of which Dr. Carpenter, member and co-director of several of the British deep-sea Expeditions, has repeatedly drawn attention.

Det er ikke sandsynligt, at Isforholdene skulde lægge den norske Expedition Hindringer ivejen for Udførelsen af denne Undersøgelse, og heller ikke for dens Fortsættelse paa Strøget nordenom Island. Ved at denne Vej følges, banes en vigtig Overgang til det egentlige Ishavsdyb, som dernæst maatte blive at gjennemskjære med et Snit fra et Punkt i nordost for Island til et Punkt paa Norges Kyst nordenfor Trondhjem. Paa denne sidste Del af Rejsen ville sandsynligvis alle Ishavsdybets vigtigste Naturforhold komme tilsyne i Iagttagelserne.

Med gunstige Vejrforhold vil den ovennævnte Del af Expeditionens Plan muligens kunne blive udført i en saavidt kort Tid, at der efter Tilbagekomsten til Norge endnu bliver Anledning til videre Undersøgelser. Om disse da bør rettes paa en Linie tvers over Ishavet mod Jan Mayen eller paa Overgangen mellem Bankerne foran Nordlands Kyst og Ishavsdybet, vil bedst den indtil da vundne Erfaring og Hensyn til den tilbagestaaende Arbejdstid kunne afgjøre.

Bestyreren af det danske meteorologiske Institut, der har Stationer i Torshavn paa Færøerne, og paa Island i Berufjord og Papey paa Sydostsiden, i Reykjavik og Stykkisholm paa Vestsiden samt i Akureyri og paa Grimsey paa Nordsiden, har anmodet Bestyreren af det norske meteorologiske Institut om under Expeditionen at inspicere de af disse Stationer, hvortil der maatte blive Anledning. Da de nævnte Stationer ere erkjendte for at være af fundamental Betydning for hele Europas og ikke mindst for Norges Meteorologi, vil Expeditionen kunne yde denne Videnskab, hvis Fremme ligger indenfor dens Arbejders Kreds, en ganske væsentlig Tjeneste ved at imødekomme det af det danske Instituts Bestyrer fremsatte Ønske. Stationerne ligge lige i den Vej, som Expeditionsskibet efter denne Plan vil komme til at følge og ville afgive de mest passende Stoppepladse til Indtagelse af Forsyninger, til Verification af Kronometrene, og de magnetiske Instrumenter, til Udførelse af Arbejder ombord, der kræve hurtigere Fremme og vanskelig kunne udføres i Søen, til Undersøgelse af Naturforholdene paa Kysten, til Tilflugtssteder under Vejrforhold, der umuliggjøre Arbejde i Søen m. v.

De Undersøgelser, der ville blive Gjenstand for Expeditionens Arbejder, ere i det væsentlige følgende:

1. *Lodninger* til Bestemmelse af Havbundens Configuration. Under disse komme Samling af Prøver af Bundens Materiale samt flere af de Operationer, der tjene til Grundlag for de nedenfor nævnte Undersøgelser.
2. Bestemmelse af *Strømmens* Retning og Hastighed. Overfladestrømmens Retning og Hastighed søges be-

That the Expedition will meet with impediments from ice, either in this region or in the tract north of Iceland, there is little reason to apprehend. This course will lead by a direct transit-passage to the depths of the Arctic Ocean, which have then to be traversed from a point north-east of Iceland to a point on the Norwegian coast north of Throndhjem. The observations taken on this, the latter part of the passage, will in all probability disclose the most important of the conditions distinguishing the depths of the Arctic Ocean.

Provided the weather be favourable, the Expedition will possibly get through this part of the Scheme and return to Norway in time for further operations. Whether, in that case, it will be best to conduct the investigation along a line traversing the Polar Sea in the direction of Jan Mayen, or in the tract extending between the banks off the coast of Nordland and the depths of the Arctic Ocean, must depend on the nature of the experience till then acquired, and on the time that may yet remain available for continuing the cruise.

The Director of the Danish Meteorological Institute, which has Stations on the Færoe Islands (Thorshavn) and in Iceland (south-east coast: Berufjord and Papey; west coast: Reykjavik and Stykkisholm; north coast: Akureyri and Grimsey), deems it highly desirable that the Director of the Norwegian Meteorological Institute should inspect such of those Stations as the Expedition may furnish opportunity of visiting. Now, the said Stations are acknowledged to be of fundamental importance to the meteorology of Europe, — and not least to that of Norway, — wherefore the Expedition could very materially promote that science by acceding to the request preferred by the Director of the Danish Institute to the Director of the Norwegian. Moreover, the Stations lie one and all in the route the Expedition will take pursuant to the Scheme of Work; they are excellently adapted for stopping-places, at which to provision the ship, verify the chronometers and the magnetic instruments, do work on board that does not admit of delay, or can with difficulty be accomplished at sea, investigate physical and other conditions on the coast, &c. &c.: and finally, they would serve as harbours in stress of weather, when all work at sea was impracticable.

The following is a General Specification of the objects which the Expedition will seek to carry out: —

1. To determine by *soundings* the contour of the seabed. When taking them, samples of the bottom will be simultaneously collected, and divers of the operations performed necessary to serve as a basis for the work specified below.
2. To determine the direction and rate of *currents*. The direction and rate of surface-currents will be

stemt dels ved hvert Lodskud, dels ved de sædvanlige nautiske Methoder. Undersøgelsen af Strømmen i Dybet vil udkræve særskilte Methoder og kun lade sig udføre under gunstige Omstændigheder. Disse sidste Undersøgelser maa i Regelen forbeholdes enkelte Punkter, hvor de ere af fundamental Betydning, som Færø-Shetland-Renden, Færø-Island-Flakket, Island-Grønland-Strædet og det kolde Ishavsdyb samt Norges Banker.

3. Bestemmelse af *Havets Temperatur* i Overfladen falder nærmest ind under de meteorologiske Iagttagelser. Dybets Temperatur ved Bunden bestemmes ved hvert Lodskud. Under gunstige Omstændigheder og paa saa mange Punkter, det maa ansees at være af Interesse, tages Rækker af Temperaturiagttagelser i forskjellige Dybder fra Overfladen til Bunden med de forskjellige Instrumenter, som Expeditionen hertil disponerer over.
4. Undersøgelse af *Havvandets fysiske* og *chemiske* Forhold: Specifisk-Vægt-Bestemmelse med Areometer. Saltholdighed (Chlormængde) ved Titrering, Luftmængde og Kulsyremængde ved Udkogning. De yderlig fornødne Analyser af de opsamlede Gasarter samt af større Prøver af Havvand, som medtages fra Steder, hvor Forholdene ere typiske, maa udføres i Laboratoriet efter Expeditionens Slutning. Ved de fleste Lodskud tages Vandprøver fra Havbunden til Bestemmelse af specifisk Vægt og Saltholdighed. Paa særegne Steder tages en Række Prøver af Vand fra forskjellige Dybder til Undersøgelse i forskjellige Retninger, dels ombord, dels senere.
5. *Zoologiske* Undersøgelser. Indsamling af Havdyr med de dertil bestemte Apparater, deres foreløbige Undersøgelse og Gruppering, deres Præparation og Opbevaring. Indsamling af Specimina af Dyreriget forøvrigt efter Lejligheden. Ved de for disse Undersøgelser nødvendige Operationer vindes ogsaa Prøver af Havbundens Materiale til Opbevaring.
6. *Botaniske* Undersøgelser: Indsamling af Specimina af Planteriget, deres Præparation og Opbevaring til videre Undersøgelse.
7. *Meteorologiske* Iagttagelser. Stadig fortsatte Iagttagelser af Barometer, Psychrometer, Vindens Retning, Styrke og Hastighed, Skyernes Mængde, Form og Bevægelse, Søgang, Nedbør m. m. Forsøg med Hygrometer til Control for Psychrometret, med Regnmaaler og Fordunstningsmaaler, med Thermometre paa forskjellige Steder og i forskjellige Højder. Maaling af Havvandets Temperatur og specifiske Vægt i Overfladen.

determined partly by the operation of sounding, and partly by the usual nautical methods. For investigating deep-sea currents, recourse must be had to special methods, practicable only under favourable circumstances. Such investigations must therefore, as a rule, be confined to a few localities in which they will be of fundamental importance, viz. the Færoe-Shetland channel, the Færoe-Iceland flat, the channel between Iceland and Greenland, the cold area of the Arctic Ocean, and the banks off the coast of Norway.

3. To determine the *Surface-temperature of the Sea,* which comes strictly within the meteorological observations. The bottom-temperature will be determined with every sounding. Under favourable circumstances, serial temperature observations will be taken, in as many localities as may be deemed desirable, at different depths, from the surface to the bottom, with the various instruments provided for the purpose.
4. To investigate the *Physical Conditions* and *Chemical Constituents* of the sea-water. This will comprise: specific gravity determinations with the areometer; salt-determinations (amount of chlorine) by titration; air and carbonic acid determinations by the boiling-process. All further analyses of gases collected on the Expedition, as also of large samples of sea-water from localities characterised by typical conditions, must be made in the Laboratory after the return of the Expedition to Norway. When soundings are taken, samples of bottom-water will be generally collected, for determining the specific gravity and the amount of salt. At certain stations, samples of water will be collected from different depths, for examination either on board or at a subsequent date.
5. *Zoological* Work, comprising the collection of marine animals, with the apparatus provided for the purpose, their preliminary examination and classification, preparing and preserving them on board, and the occasional collection of other specimens of the animal kingdom. When conducting the operations for capturing marine animals, samples of the bottom will also be collected.
6. *Botanical* Work, comprising the collection of specimens of the vegetable kingdom, and preserving them for subsequent examination.
7. *Meteorological* Observations, comprising regular readings of the barometer and psychrometer; observations of the force, direction, and velocity of the wind, the form, amount, and motion of clouds, the state of the sea, precipitation, &c., &c.: experiments with the hygrometer, to control the psychrometer, with the rainguage, and with thermometers in different localities and at different heights above the level of the sea; determinations of the temperature of the sea and of the specific gravity of the water at the surface.

8. *Magnetiske* Iagttagelser. Daglige — om Vejret tillader det — Bestemmelser af Misvisningen, Inclination og Intensitet. Observationernes Beregning saavidt ske kan. Observationer paa Land- (Basis-)Stationer til Bestemmelse af de nødvendige magnetiske Konstanter.
9. Lejlighedsvise Iagttagelser, hvortil Tid og Sted maatte give Anledning, saasom hydrografiske Undersøgelser, astronomisk-geografiske Stedbestemmelser, geologiske Iagttagelser m. m.

Den 14de April blev Dampskibet "Vøringen" i Bergen overtaget for Expeditionens Regning, og det overdroges D'Hrr. Brunchorst & Dekke at udføre Forandringerne og Indredningsarbejderne efter den vedtagne Plan. Mod Slutningen af Maj Maaned var disse færdige og samtlige Apparater saavidt muligt paa Plads, hvorefter Expeditionens Deltagere, Professorerne Mohn og Sars, Dr. Danielssen, Hrr. Friele, Hrr. Svendsen og Landskabsmaler Schiertz embarkerede. Som Skibsofficerer var antagne Premierlieutnant i Marinen *R. M. Petersen* og Skibsfører *J. Grieg*.

Om Morgenen den 1ste Juni afgik Expeditionen fra Bergen og sejlede ind i Sognefjorden, hvor den samme Dags Eftermiddag ankrede i Esefjord. Efter nogle Forberedelser foretoges i Fjorden udenfor Esefjord de første Lodninger og Skrabninger til Prøve. Lodningen foregik strax uden Vanskelighed. Ved den første Skrabning havde vi det Uheld, at Skrabetouget sprang, uden synderlig paagaaende Kraft, paa Grund af en Fejl i Sammenslagningen, hvilket var saameget mere uheldigt, som det vakte Tvivl om Tougverkets Godhed. Dette viste sig imidlertid senere udmærket, og den første var den eneste Skrabe, der paa hele Expeditionen gik tabt af denne Aarsag. Den næste Skrabning var ogsaa uden Resultat, da Farten havde været for stor, hvorved Skraben strax løftedes fra Bunden, men hermed var ogsaa den fornødne Erfaring indvunden med Hensyn til denne Manøvre.

Anden Pintsedag, den 5te Juni, foretoges en Excursion til Bojum-Bræen i Fjærland. Forøvrigt anvendtes Tiden med Klargjøring af Lodde- og Skrabe-Apparaterne og med deres Anvendelse paa Dybet. Den 8de Juni gik vi udover Sognefjorden, tog nogle Lodskud udenfor Bøfjorden, hvor Dybden endnu var 600 Favne og ankrede om Aftenen paa nævnte Sted. Den 9de om Morgenen bestemtes

8. *Magnetical* Observations (taken daily, weather permitting), to determine declination, inclination, and intensity, so far as practicable, with computation of the results. For determining the magnetic constants, observations will be instituted on shore, at base-stations.
9. Occasional observations, for which time and place may furnish opportunity, such as hydrographical observations, observations of latitude and longitude, geological observations, &c. &c.

On the 14th of April the S.S. "Vøringen," lying in the port of Bergen, was taken in charge for the Expedition, and Messrs. Brunchorst & Dekke commissioned to undertake the necessary alterations &c. in conformity with the approved plan. By the latter end of May the vessel was ready for sea; and all instruments and apparatus having been got on board, and so far as possible arranged, the several members of the Expedition, — Professors Mohn and Sars, Dr. Danielssen, Mr. Friele, Mr. Svendsen, and an artist, Mr. Schiertz, forthwith embarked. The chief officers (exclusive of the captain) were — *R. M. Petersen*, R.N., first lieutenant; *J. Grieg*, merchant-captain.

On the morning of the 1st of June the Expedition left Bergen, steaming northward for the Sognefjord, which it reached on the afternoon of that day, and cast anchor in the Esefjord, an arm of the above. After a few preparations, the first soundings and dredgings were commenced, off the mouth of the Esefjord. No difficulty whatever attended the former operation; but at the first trial with the dredge, the rope, though not exposed to any considerable strain, unfortunately parted, owing to some defect in the manufacture; which was the more to be regretted, since it gave reason to apprehend that the general quality of the rope-work supplied to the Expedition might prove inferior. Happily, however, it turned out to be excellent, and no other dredge was lost in this manner. The next dredging also proved unsuccessful, from the speed of the vessel, which was too great, causing the dredge to be lifted off the bottom. Meanwhile, sufficient experience had been acquired in the use of the apparatus.

On Whit Monday, the 5th of June, an excursion was made to the Bojum glacier, in Fjærland. The following days were occupied with getting in order the sounding and dredging apparatus, and working them in deep water. On the 8th of June we steamed out of the Sognefjord, took a few soundings off the Bøfjord, where the depth was still found to be not less than 600 fathoms, and in the

Bundens Opgang fra det store Dyb inde i Sognefjorden til dennes ydre grundere Del og toges et Par Skraber i denne sidste, hvorpaa Expeditionen gik ud til Husø ved Fjordens Munding. Her blev den liggende i 10 Dage, der anvendtes til magnetiske Observationer i Land og til Svingning af Skibet för at bestemme de magnetiske Constanter for Navigationen og for de magnetiske Instrumenter ombord. Til samme Tid toges daglig Skrabninger fra Baad af Zoologerne.

Den 20de Juni gik Expeditionen tilsøs. Vejret, der under Opholdet i Husø havde været noget uroligt blev efterhaanden udmærket. Overensstemmende med Planen begyndte man strax med Bestemmelsen af den langs Kysten løbende dybe Rendes Affald mod Ishavet. Under dette Arbejde fik vi første Gang iskoldt Vand i Dybet om Aftenen den 21de Juni paa 62° 45′ N. Br. og 1° 48′ L. Ø. f. Gr. og ved Skrabningen sammesteds den første *Umbellularia*. Til Middag den 23de arbejdedes Dag og Nat med Lodninger, Skrabninger, Temperaturrækker og Optagning af Vandprøver fra Bund og Overflade. Skibets Vej og de Stationer, hvor der er foretaget Undersøgelser, er afsatte paa det medfølgende Oversigtskart.

Fredag den 23de Juni ankom Vøringen til Kristiansund. Den 24de og 26de anvendtes til at fylde Kul og Vand samt gjøre nogle mindre Anskaffelser. Mandskabet blev forøget med 3 Mand, da Zoologerne tiltrængte mere Assistance end paaregnet, ligesom Arbejdet med Apparaterne viste sig mere anstrængende for Folkene, end man havde tænkt sig.

Tirsdag den 27de Juni afgik Expeditionen atter fra Kristiansund, og ud paa Storeggen, hvor der toges 10 Lodskud og 5 Bundskrabninger, hvorpaa Kursen sattes videre vestover. Den 30te Juni loddedes, trawledes og skrabedes i 525 (eng.) Favne og den 1ste Juli i 587 Favne paa 63° 5′ N. Br., 0° 53′ L. Ø. f. Gr. Lige siden Afgangen fra Husø havde Vejret været særdeles smukt, men den 1ste Juli begyndte den første Storm, og siden holdt Vejret sig usædvanligt ugunstigt lige til den 15de August.[1] Kl. 10 om Aftenen den 1ste Juli var Vindens Hastighed 20 Meter i Sekundet, Vindens Retning SSØ. og Fartøjets Kurs ØSØ, begge retvisende. Bølgernes Højde maaltes til 5—6 Meter. Da Vinden efterhaanden gik om paa SV., lagdes Kursen om Eftermiddagen den 2den Juli mod Vest. Vinden var svagere, men Søgangen hindrede fremdeles vore Arbejder paa Dybet. Den 3die Juli avancerede vi fremdeles langsomt vestover, men uden at kunne bruge Dybhavsapparaterne. Vinden var noget mindre stærk, men Søen fremdeles urolig, Bølgehøjden 3 Meter. Den 4de Juli om Morgenen

[1] Man se "Cartes synoptiques journalières, construites par N. Hoffmeyer, directeur de l'institut météorologique Danois," i hvilke vor Expeditions meteorologiske Iagttagelser er benyttede.

evening ran in shore to anchor. On the morning of the 9th was determined the rise of the bottom from the great inner depths of the Sognefjord to its shallower outer part, where we took one or two hauls of the dredge, and then proceeded on to Husø, at the mouth of the fjord. Here the Expedition remained 10 days, with the object of instituting magnetical observations on shore, and of swinging ship for deviation and determining the constants of the magnetical instruments. During our stay the zoologists dredged the bottom daily from a boat.

On the 20th of June the Expedition put to sea. The weather, which had been somewhat blustering at Husø, now began to moderate, and turned out remarkably fine. Agreeably to the approved plan, we at once proceeded to investigate the deep channel that stretches along the coast, and to explore its slope towards the basin of the Arctic Ocean. Whilst thus engaged, we struck in the depths, for the first time, water of 0° temperature, on the evening of the 21st, lat. 62° 45′ N., long. 1° 48′ E., and a haul of the dredge brought up our first specimen of *Umbellularia*. Till noon of the 23rd, our time was fully occupied with sounding, dredging, taking serial temperatures, and collecting samples of sea-water from the bottom and from the surface. The accompanying Plate shows the track of the ship and the Stations at which any exploring work was done.

On Friday the 23rd of June the "Vøringen" reached Christiansund. Two days — the 24th and the 26th — were passed in taking in coal and water, and otherwise completing the equipment of the vessel. At this port 3 additional hands were shipped, the zoologists needing increased assistance; the working the apparatus ship, too, had proved more laborious than originally anticipated.

On Tuesday the 27th of June the Expedition left Christiansund, and steamed out to the *Storeggen* bank. Here we took a series of 10 soundings and 5 hauls of the dredge, after which the vessel pursued her westward course. On the 30th of June we sounded, trawled, and dredged, in 525 fathoms; and on the 1st of July, in 587 fathoms, lat. 63° 5′ N., long. 0° 53′ E. Since our departure from Husø the weather had been uncommonly fine; but on the 1st of July it blew a heavy gale, and from that date to the 15th of August the weather continued exceptionally foul.[1] On the 1st of July, at 10 p. m., the velocity of the wind was 20 metres a second, its direction (true) SSE., and the course of the vessel (true) ESE.; height of the waves 5—6 metres (18 feet). The wind having gradually veered to the south-west, on the afternoon of the 2nd the ship was given a westward course. The wind had fallen off, but the sea was still too high to admit of deep-sea operations. On the 3rd of July we continued steaming slowly westward, with no possibility however of working

[1] *Vide* "Cartes synoptiques journalières, construites par N. Hoffmeyer, directeur de l'institut météorologique Danois." in which part of our meteorological observations are incorporated.

første Skrabning satte Skraben sig fast i den ujevne, haarde Bund, og efter langvarige Manøvrer for at faa den løs, maatte Touget sprænges. Vejret holdt sig taaget og regnfuldt med sydlig og sydøstlig Bris og uroligt Hav, hvorfor Undersøgelsen af Partiet mellem vor nordligste Station og Langanes, den nordøstlige Pynt af Island, opgaves, og Kursen sattes østover.

Den 8de loddedes og trawledes i 1861 Favne, det største Dyb, vi fandt i 1876, paa 65° 48′ N. Br. 3° 7′ L. V. f. Gr. Kulingen tiltog imidlertid igjen, saaat der sattes igang østover med kun halv Fart, og den næste Dags Eftermiddag blev Stevnen sat op mod Søerne, da Skibet slingrede for voldsomt med Søen tvers. Om Morgenen den 10de August sattes atter Kurs for Station, og Kl. 10 toges Lodskud paa 1539 Favne. Uagtet det var stiv Kuling (Vindhastighed 10 til 16 Meter pr. Sekund) og uroligt Hav, blev dog Bundskrabning udført fra Kl. 11 Form. til Kl. 7 Aften, hvorefter Kursen atter sattes østover, men om Morgenen den 11te maatte Stevnen atter sættes mod Søerne. Den næste Nat sejledes nogle Timer Kurs, og da Station naaedes, toges, uagtet det ugunstige Vejr fremdeles vedvarede med stiv Kuling og høj Sø, Lodskud og Temperaturrække. Da Dybden ikke var mere end 600 Favne, og Rejsen saavidt fremskreden, at et Tab af Apparater var af mindre Betydning, forsøgtes det Experiment at bruge til Bundskrabning Skrabe og Trawl paa en Gang, idet Otertrawlen gjordes fast bag efter Skraben. Experimentet lykkedes ogsaa forsaavidt, at Skraben kom vel ombord igjen, men Trawlen, der ikke hurtigt nok kunde hales ombord i sin hele Længde, blev grebet af Skruen, førend denne kunde standses. Vi satte da Sejl til og holdt undaf Vejret, og med megen Besværlighed, paa Grund af den høje Sø, blev saa meget af Trawlen bortkappet ved Hjelp af Knive og skarpe Spadeblade, fæstede til lange Stager, at Skruen efter et Par Timers Forløb atter kunde sættes i Gang. Kursen sattes nu mod Land, men næste Dag maatte atter Stevnen sættes mod Søerne, indtil en efter Middag erholdt Solhøjde gav Skibets Plads, saaledes at der kundes styres lige mod Halten Fyr, hvis Taarn ogsaa nogle Timer senere viste sig ret forud. Samme Dags Aften bragtes Vøringen til Ankers i Haltens Havn, efter i Løbet af 6 Uger at have udholdt 8 Storme. Den næste Dag, den 14de August, gik Expeditionen til Namsos.

I Namsos laa Expeditionen i 6 Dage, og under dette Ophold blev taget magnetiske og astronomiske Observationer i Land. Den 20de August gik Expeditionen atter tilsøs, og samme Dags Aften paabegyndtes Arbejderne atter udenfor Kysten. Med vestlig Kurs toges en Lodskudrække

and by the evening of the 7th had run 240 miles. At the first haul, the dredge caught against the hard and rugged bottom, and we were obliged to break the rope, after manifold manœuvres to disengage the apparatus. The weather still continuing wet and foggy, with strong winds from the south and south-east and a heavy sea, we decided on giving up the investigation of the tract between our most northerly observing-station and Langanes, the north-eastern promontory of Iceland, taking instead an eastward course.

On the 8th we sounded and trawled in 1861 fathoms, the greatest depth measured in 1876, lat. 65° 48′ N., long. 3° 7′ W. Meanwhile, it was again blowing so hard that we had to steam eastward at half speed: and on the afternoon of the following day the vessel was put head to sea, as she rolled too heavily with the sea on her beam. On the morning of the 10th of August we stood for the next observing station, and at 10 a. m. took a sounding in 1539 fathoms. Though it blew a gale (velocity of the wind from 10 to 16 metres a second) and the sea ran high, still we managed to dredge the bottom, — an operation which lasted from 11 a. m. to 7 p. m. Proceeding then on our eastward course, the next morning heavy weather again compelled us to put the ship with her head to the sea. During the night, the wind having fallen off a little, she was able to steam on her course for a few hours: and, arrived at the next observing station, we took, notwithstanding the very unfavourable weather, — it was still blowing hard with a heavy sea, — both soundings and serial temperatures. The depth here not exceeding 600 fathoms, and the advanced stage of the cruise rendering a possible loss of apparatus of less moment, the experiment was tried of working trawl and dredge simultaneously, the otter-trawl being made fast behind the dredge. The experiment succeeded, in so far at least as the dredge came safely on board; but the trawl, from its great length, could not be hove quick enough, and fouled the propeller, ere there was time to stop the engines. Getting sail on the ship, we ran before the wind, and with great difficulty, owing to the heavy sea, succeeded, after a couple of hours' unremitting exertions, in cutting away sufficient of the trawl, by means of knives and sharpened spade-blades at the end of long poles, to free the propeller. We now stood for the land, but next day the vessel lay to with her head to the sea till an observation of the sun's altitude, taken an hour after noon, had given us her position, and we could steer direct for the Halten lighthouse, the tower of which hove in sight a few hours after. On the evening of that day the "Vøringen" was moored in the harbour of Halten, having encountered a continued succession of heavy gales — no less than 8 — in the course of her six weeks' cruise. On the morrow, the 14th of August, the Expedition proceeded to Namsos.

At this place we remained 6 days, our stay being chiefly devoted to the taking of magnetical and astronomical observations on shore. On the 20th of August the Expedition again put to sea, and in the evening the exploratory work off the coast was resumed. Standing west,

paa 31 Stationer med 1 Mils Afstand indbyrdes, samt en Bundskrabning. Kystbankens Afheld mod Ishavsdybet fandtes først i en Afstand af 25 Mil fra Land og først her fandtes, i 381 Favne, iskoldt Vand ved Bunden. Kursen sattes derefter sydover og Opgangen fra Dybet af den samme Banke blev bestemt paa 64° Bredde, hvor der blev taget 6 Lodskud, 2 Temperaturrækker og 2 Bundskrabninger. Dette Arbejde blev udført til om Aftenen den 22de August, og da ophørte ogsaa det gode Vejr, som vi siden Ankomsten til Namsos havde havt.

I Taage og Kuling gjordes Land næste Morgen, den 23de August, ved Ona Fyr, hvor Lods kom ombord, og om Eftermiddagen ankredes ved Molde. Den 24de blev der loddet, taget Temperaturrække, og skrabet i Romsdalsfjorden, og samme Dags Aften ankom Expeditionen til Aalesund. Her kom der Kl. 8 om Aftenen en Stormbyge, der rev Skibet løs fra sine Fortøjninger, og først Kl. 2 om Morgenen blev det atter bragt paa sikker Ankerplads igjen. Den næste Formiddag afgik vi fra Aalesund, laa om Natten i Florø og ankom Lørdag Middag den 26de August til Bergen.

Samtlige Expeditionens Medlemmer debarkerede samme Dag, og Mandag Morgen begyndte Desarmeringen, idet alle Expeditionens Sager bragtes i Land paa Marinens Værft, hvor det fornødne Magazinrum velvilligen var stillet til Expeditionens Raadighed. Samtidig udtoges Indredningen, og Skibet klargjordes til Fragtfart ved D'Hrr. Brunchorst & Dekkes Værft, hvorfra det den 7de September afleveredes til Rederiet.

1877.

Den for dette Aar vedtagne Plan var saalydende:

Fartøjets Udrustning og Bestemmelsen af dets magnetiske Konstanter antages færdige til den 1ste Juni.

Ved Studiet af Varmeforholdene i Dybet over Bankerne udenfor Vestkysten har det vist sig, at der endnu savnes nogle Temperaturrækker i den norske Rende. For at faa disse, begyndes Vejen til det egentlige Undersøgelsesfelt saaledes, at man fra Bergen gaar direkte tilsøs og, følgende Rendens Bund, tager nogle Temperaturrækker i denne. Længere Nord kunne nogle af forrige Aars Temperaturrækker verificeres.

Det første egentlige Arbejdsfelt er de norske Kystbanker nordenfor Namdalen.

Efter de Observationer, som foreligge, er det sandsynligt, at Havbroen, hvor Banken kaster sig ned mod Ishavsdybet, og hvor det iskolde Vand begynder ved Bunden,

we took a series of soundings at 31 Stations, 4 miles apart, and one haul of the dredge. The slope of the coastal bank towards the basin of the Arctic Ocean was found to commence 100 miles from land, and here, in 381 fathoms, we first met with bottom-water of 0°. Proceeding then on a southward course, the rise of the bank was determined in lat. 64° N., and here we took 6 soundings, 2 serial temperatures, and 2 hauls of the dredge. This deep-sea work was steadily prosecuted till the evening of the 22nd of August, when a gale of wind put an end to the spell of fair weather we had enjoyed after reaching Namsos.

Steaming southward in a fog and a heavy sea, we made land the next morning, the 23rd of August, near the Ona lighthouse; soon after a pilot came on board, and in the afternoon the "Vøringen" cast anchor at Molde. The next day we sounded, took a series of temperatures, and dredged in the Romsdalsfjord, the Expedition proceeding that day as far as Aalesund. At 8 p.m. the ship, struck by a violent squall, broke from her moorings, and it was 2 o'clock in the morning before she got safe anchorage. On the forenoon of the following day we left Aalesund, anchored for the night at Florø, and arrived at Bergen on Saturday the 26th of August, about noon.

The members of the Scientific Staff disembarked the same day. In the course of the next week the instruments, apparatus, and other things belonging to the Expedition were conveyed to the Royal Navy Yard (storage-room had been kindly placed at my disposal), and the crew paid off. The fittings below deck were then removed, and the vessel cleared for the freight-trade, in Messrs Brunchorst & Dekke's dockyard, where, on the 7th of September, she was given up to the owners.

1877.

The Scheme approved for this year was as follows: —

The equipment of the vessel and the determination of her magnetic constants are assumed to have been completed by the 1st of June.

Extended research into the thermal conditions of the deeper strata on the banks off the West Coast of Norway, has shown a few serial temperatures to be wanting for the Norwegian Channel. The Expedition will, therefore, on leaving Bergen, at once put to sea, and, following the axis of the channel, commence its exploratory work by taking serial temperatures. Farther north, a few of last year's serial temperatures might be verified.

The Norwegian coastal banks north of Namdalen will form on this cruise the first extensive field of exploratory research.

Judging from the observations already taken, it is highly probable that the edge of the bank where the sea-bottom begins to slope down towards the depths of the Arctic

ligger mindst 25 Mil ud fra Kysten. Mellem Røst og det Punkt udenfor Namdalen, hvor Expeditionen ifjor fandt omkring 60 Favnes Dyb med Fjeldbund 10 Mil af Land, antages det muligt, at der gaar en mere eller mindre sammenhængende Fjeldkam. Havbroens og den formodede Fjeldkams Sted og Naturforhold danne fremtrædende Punkter i Undersøgelsen af Bankerne. Denne foregaar ved Opgaaelse af Tversnit lodret mod Kysten. Tversnittene tages — i Overensstemmelse med forrige Aars — i en indbyrdes Afstand af 12 til 13 geografiske Mil. Deres indre Grændse er den yderste Linie for den specielle hydrografiske Kystundersøgelse. Deres ydre Grændse er der, hvor Temperaturen ved Havbunden er — 1° eller henimod denne.

Til Bestemmelse af Temperaturforholdene kræves i hvert Tversnit foruden Temperaturen ved Bunden ved hvert Lodskud, mindst 3 Temperaturrækker: en ved den indre Grændse, en ved Havbroen, paa dens indre Kant, og en ved Snittets ydre Grændse. Lodskuddenes Antal beror paa, om man under Arbejdet finder Bunden mere eller mindre jevn.

For at levne saameget Tid som muligt til Arbejderne i det store Ishavsdyb og ved Jan Mayen samt Grønlandsisen, medtages ved Bankernes Undersøgelse, i hvert 3die Tversnit, Undersøgelsen af Umbellularia-Regionen indtil et Dyb af 1000 Favne. Skulde Forholdene tillade det, kunne ogsaa flere af Banktversnittene udvides til denne Udstrækning. Under Arbejdet paa Bankerne og i Umbellularia-Regionen antages det hensigtsmæssigt at anløbe Bodø.

En Temperaturrække i Vestfjorden, udført med de nyeste Dybvandsthermometre, søges erholdt saavel paa Rejsen opover i Juni som paa Tilbagerejsen i August, til Undersøgelse af det abnorme Forhold, som fandtes her i Sommeren 1875, idet Temperaturen havde et Minimum i 70 Favnes Dyb. Da de zoologiske Undersøgelser i Vestfjorden hidtil kun omfatte Kysternes Fauna, søges Anledningen benyttet til zoologiske Arbejder i denne Fjord i større Afstand fra Land.

Magnetiske absolute Observationer søges udført paa Røst, hvor Forholdene derfor ifølge Lieutenant Petersens Observationer i 1875 antages gunstige, og hvor man har det mest fremskudte Punkt til Sammenligning med de eventuelle magnetiske Observationer paa Grønlandsisen.

I Løbet af Juni Maaned antages, under gjennemsnitlige Vejrforhold og med den fra ifjor hentede Erfaring, Undersøgelsen af Bankerne og Umbellularia-Regionen efter denne Plan at kunne naa til Bredden af Tromsø.

I Tromsø antages Expeditionen sidst i Juni eller først i Juli at kunne blive udrustet til en længere Rejse vestover.

Ocean, and where the temperature at the bottom falls below 0° C., lies not less than 100 miles distant from the coast. The section of the sea-bed between Røst and the point off Namdalen where, on last year's cruise, the depth, 40 miles from land, was found to be 60 fathoms, with a rocky bottom, will possibly prove to be traversed by a more or less continuous submarine ridge. To determine the exact position of the edge of the bank and of this supposititious ridge, and thoroughly to investigate their physical conditions, form important points in the exploration of the banks. This can be done by means of transverse sections perpendicular to the coast, at distances, as on last year's cruise, of about 50 miles. The inner limit of these sections to coincide with the extreme boundary line for the special hydrographic Coast Survey, their outer extending to where the temperature at the bottom is about — 1°.

To determine the thermal conditions, at least 3 serial temperatures will have to be taken in each section, exclusive of the temperature registered with each bottom-sounding, viz. — one at the inner limit, one on the edge of the bank, and one at the outer limit of the section. The number of soundings will depend on the contour of the bottom, whether it be more or less undulating.

With the object of prolonging the period for the exploration of the great Arctic basin, the depths off Jan Mayen, and the Greenland ice-barrier, it is deemed advisable that the work on the banks be made to embrace, in every third section, down to a depth of 1000 fathoms, the investigation of the *Umbellularia* region. Circumstances permitting, several of the transverse sections may be extended accordingly. When exploring the banks and the *Umbellularia* region, the Expedition should touch at Bodø.

A series of temperatures should, if possible, be taken in the Vestfjord with the latest deep-sea registering thermometers, both on the passage north in June and on the homeward course in August, to determine the abnormal condition observed here in the summer of 1875, viz. of a minimum temperature at a depth of 70 fathoms. Zoological investigations in the Vestfjord having hitherto been confined to the littoral fauna, the naturalists accompanying the Expedition will take every advantage of the opportunity afforded them to explore this fjord at a greater distance from land.

Absolute magnetical observations will, if possible, be taken at Røst, — the most advanced point on the coast, — where the physical conditions, as determined by lieutenant Petersen in 1875, are, it is believed, sufficiently favourable, for comparison with the magnetical observations to be instituted on the Greenland ice-barrier.

By the end of June, in moderately fair weather, the exploration of the banks and the *Umbellularia* region will, it is believed, inferring from last year's stormy cruise, have reached the latitude of Tromsø.

Refitting at Tromsø for a cruise westward of greater duration, the "Vøringen" will, it is hoped, be ready to leave that port by the end of June or the beginning of July.

Man gaar først efter Linien Andø—Jan Mayen ud i Ishavsdybet, undersøger dette og dets Skraaninger paa begge Sider. Omkring Nordøstenden af Jan Mayen som Centrum foretages nogle kortere Rækker Lodskud mod Nordøst, mod Nord og mod Nordvest. Paa dette Strøg nemlig, der antages at danne den islandske Vulkan-Regions yderste Forbjerg mod Nordøst, synes Bunden at falde særdeles brat af mod Dybet til de nævnte Sider.

Under den sandsynlige Forudsætning, at Adgangen til Jan Mayen ikke er spærret af Is, forsøges det at lande paa Øen til Foretagelse af Undersøgelser i geografisk, geologisk, hydrografisk, zoologisk, botanisk Retning m. v.

En Undersøgelse af Naturforholdene i Havet paa Vest- og Sydsiden af Jan Mayen søges udført. Der er nemlig Grund til at antage, at Jan Mayen er forbundet med Island ved en undersøisk Ryg.

For at undersøge Forholdene paa Grændsen mellem den varme Overfladestrøm fra Atlanterhavet og den kolde Polarstrøm i Grønlandshavet, opsøges Grønlandsisen i Nordvest for Jan Mayen. Naar Undersøgelserne langs et Stykke af Grønlandsisen ere afsluttede, styres til et Punkt omtrent midtvejs mellem Island og Jan Mayen, og derfra undersøges Tversnittet over Ishavsdybet i Retning af Ranen. Herved vil man kunne faa rede paa den formodede undersøiske Ryg mellem Island og Jan Mayen. Naar det sidstnævnte Tversnit er oparbejdet indtil dets tidligere undersøgte norske *Umbellularia*-Region, sejles til Tromsø, under Forudsætning af, at Tiden senere tillader, i August, flere Arbejder nordenfor Tromsø.

Naar Juli Maaned antages medgaaet til Jan Mayen-Turen, vil den første Halvdel af August kunne anvendes til Undersøgelse af Bankerne, Havbroen og endel af Ishavsdybet mellem Norge og Syd-Spidsbergen. Som Østgrændse sættes Linien Nordkap, Bjørneøen, Sydkap.

Den sidste Halvdel af August vil tiltrænges til Tilbagerejsen til Bergen og Desarmering.

De videnskabelige Arbejder udføres væsentlig paa samme Maade som i 1876.

Ved de zoologiske Arbejder lægges ved Siden af Fangst med Skrabe, Trawl og Svabere, særlig Vægt paa Anvendelse af Drivgarn og Net i intermediære Dybder, samt Fiskeri paa Bankerne. Paa Jan Mayen antages Fuglefangst at burde være Gjenstand af Betydning og ved Grønlandsisen muligens Fangst af Sæl og Isbjørn m. m.

Her course west will at first coincide with a line extending from Andø to Jan Mayen, and thence to the Arctic Ocean, the basin and slopes of which the Expedition has to investigate. From the north-eastern extremity of Jan Mayen will be taken a few short series of soundings in a north-easterly, a northerly, and a north-westerly direction; for off this point, which is supposed to form the north-eastern promontory of the volcanic region of Iceland, the bottom would appear to sink precipitately in those directions.

On the probable assumption that Jan Mayen is not inaccessible from ice, the Scientific Staff will land on the island, and prosecute exploratory work in divers branches — geographical, geological, hydrographical, zoological, botanical, &c.

The physical and biological conditions of the sea off the western and southern shores of Jan Mayen, should if possible be investigated, there being some reason to infer that a submarine ridge connects that island with Iceland.

To investigate the conditions where the warm surface-current from the Atlantic meets the glacial Polar flow in the Greenland sea, the Expedition will stand north-west of Jan Mayen when making for the Greenland ice-barrier. After exploring part of the Greenland ice-barrier, the Expedition will proceed to a point about midway between Iceland and Jan Mayen, and from thence investigate the bed of the Arctic Ocean in the direction of Ranen. The existence or non-existence of a submarine ridge connecting together Jan Mayen and Iceland will then be definitively settled. When the last-mentioned section of the Arctic basin has been explored throughout, irrespective of its Norwegian *Umbellularia* region, investigated previously, the Expedition will return to Tromsö, provided there be time for subsequent exploratory work (in August) north of that port.

If, as expected, the Expedition get back from Jan Mayen by the end of July, the first half of August can be devoted to further investigation of the banks, and part of the Arctic basin between Norway and the southern extremity of Spitzbergen. A line tangent to the North Cape, Beeren Eiland, and South Cape marks the eastern limit of the tract to be explored.

The latter half of August will be needed for the passage home to Bergen, and for discharging the vessel.

The scientific work of the Expedition to be carried out in all essential particulars as in 1876.

With regard to the zoological work, especial stress is laid on the use of the surface-net, and of the drag-net in intermediate depths, apart from that of the dredge, trawl, and swabs, as also on fishing when exploring the banks. During the stay at Jan Mayen, some time should, it is thought, be devoted to collecting ornithological spec-

Ved Lodskuddene søges bestemt Bankernes Form og Udstrækning, samt den Maade, paa hvilken Bunden falder af fra disse til de største Dybder i Ishavsdybet. Det er af fundamental Betydning for Forstaaelsen af Havets og de tilgrændsende Landes orografiske og geologiske Forhold, ligesom for Dyrelivets Udbredelsesforhold, at faa afgjort, om Bunden falder jevnt af mod Dybet, eller om den falder af i Trin, Terrasser eller Afsatser med mellemliggende Plateauer. Lodskuddenes Plads og Antal bestemmes derfor med disse Hensyn for Øje.

Maalingerne af Havets Temperatur i Dybet udføres i den Udstrækning, som er nødvendig til en sikker Bestemmelse af Dybets Isothermer i de efter denne Plan opgaaede Tversnit. Der tages Hensyn til det hensigtsmæssige i, at Punkterne i Tversnittene ogsaa kunne anvendes til Længdesnit. De nyeste Dybvandsthermometre anvendes saa ofte som muligt ved Siden af det ifjor brugte.

Ved hvert Lodskud tages Vandprøve fra Dybet og paa udvalgte Steder fra intermediære Dybder. Alle Vandprøvers specifiske Vægt bestemmes.

Ved hvert Lodskud tages Bundprøver, der opbevares til videre Undersøgelse. Af de med de zoologiske Fangstapparater optagne og sigtede Materiale af Havbunden tages Prøver til Opbevarelse.

De chemiske Arbejder udføres væsentlig som ifjor. Den specifiske Vægt af Havoverfladens Vand bestemmes en til to Gange daglig, og oftere paa Steder, hvor Strømforhold eller andre Forhold gjøre det ønskeligt.

Iagttagelsen af Strømmen i Havet søges udført, naar Naturforholdene gjøre det ønskeligt og Vejrforholdene muligt.

Magnetiske Observationer søges udført ombord i Søen, navnlig lægges Vægt paa Erholdelsen af Misvisningsobservationer. Absolute Bestemmelser søges udført paa Røst og paa Grønlandsisen, foruden ved Bestemmelsen af Skibets magnetiske Constanter i Husø, og desuden, hvor Lejligheden ellers maatte findes, som i Bergen, Bodø, Tromsø m. fl.

Geologiske Undersøgelser foretages paa Jan Mayen, om Landgang der er mulig, i al den Udstrækning, som Forholdene tillade. Paa Jan Mayen vil astronomisk-geografiske Stedbestemmelser, topografiske og hydrografiske Undersøgelser være af største Interesse at faa udført. En Stedbestemmelse paa Røst — i Forbindelse med de magnetiske Observationer — vil være ønskelig, da Stedet ikke er forbundet med det trigonometriske Net.

imens; and at the Greenland ice-barrier there might, perhaps, be opportunity of capturing a few seals, with an occasional shot at a Polar bear.

Deep-sea soundings will be taken to determine the contour and extent of the coastal banks, as also their slope, or how the bottom shelves down into the greatest depths of the Arctic Ocean. It is a point of fundamental importance in studying the orographical and geological conditions of the sea and the countries it surrounds, and the distribution of animal life in the ocean, to find whether the bottom slopes gradually down to the depths, or descends, as it were, step by step, in terraces, with interjacent plateaus. Hence, the position and number of the soundings will have to be determined with this object in view.

The temperature of the sea will be taken to the extent required for an indisputable determination of the isotherms of the transverse sections explored in accordance with the present scheme. Attention is directed to the position of the observing points in the transverse sections, which should admit of their being applied to longitudinal sections. Whenever practicable, the temperature shall be registered with the latest deep-sea thermometers as well as with the instrument used on last year's cruise.

With every sounding, a sample of water shall be brought up from the bottom, and in specially selected localities also from intermediate depths. All the samples to have their specific gravity determined.

With every sounding, a sample of the bottom shall be obtained, and preserved for subsequent examination. Samples of the sifted material brought up from the bed of the ocean with the dredge or trawl will also be preserved.

In the chemical work there will be no essential change. The specific gravity of the surface-water shall be registered once or twice a day, and more frequently in localities where the action of currents or other exceptional conditions may render it desirable.

Observations on ocean-currents will be made wheresoever the attendant physical conditions may render them desirable and the state of the weather practicable.

Magnetical observations shall, if possible, be taken at sea, especial stress being laid on obtaining determinations of the variation of the compass. Absolute determinations shall, if possible, be performed at Røst and on the Greenland ice, exclusive of those for the ship's magnetic constants to be made at Husø; and wheresoever else opportunity may be afforded, as at Bergen, Bodø, Tromsø etc., and other places.

Geological investigations will be undertaken on the island of Jan Mayen, should the Expedition succeed in landing there. Peculiar interest would likewise attach to astronomical determinations of latitude and longitude, as also to topographical and hydrographical observations made on that island. In connexion with the magnetical observations instituted at Röst, it will be desirable to perform determinations of latitude and longitude, that locality not being included in the trignometrical net of the country.

Botaniske Undersøgelser og Indsamlinger søges gjort paa Jan Mayen i størst mulig Udstrækning.

De meteorologiske Iagttagelser ombord udføres i alt væsentligt som i 1876.

Ligesom det foregaaende Aar overtoges Dampskibet "Vøringen" af Expeditionen den 14de April og Indredningsarbejderne udførtes ved samme Værft.

Den 19de Maj paamønstredes Mandskabet, og Kl. 2 om Morgenen den 23de Maj afgik Skibet til Husø, hvor jeg agtede at tage de til Fox-Cirkelens senere Benyttelse nødvendige forberedende Observationer. Efter Ankomsten hid opdagedes imidlertid en Fejl i agterste Krumtappinde, og da Vejret desuden var til Hinder for Observationernes Udførelse, returneredes strax til Bergen, hvor ny Mellemaxel blev indsat. Dette Arbejde var færdigt den 31te Maj, men Expeditionens Afgang blev yderligere forsinket derved, at Mr. Macintosh i London, der havde paataget sig til første Halvdel af Maj at levere nye Accumulatorstrenge, havde glemt Ordren og kunde ikke levere dem før 10de Juni. Der blev derfor gjort et nyt Forsøg paa at erholde de forberedende magnetiske Observationer, men det mislykkedes fuldstændigt paa Grund af det yderst urolige Vejr i Husø.

Den 11te Juni embarkerede i Bergen Professorerne Mohn og Sars, Overlæge Danielssen og Landskabsmaler Schiertz samt Overlæge Hansen, der havde erholdt Indredepartementets Tilladelse til at være med som Passager til Tromsø, hvor Kjøbmand Friele skulde støde til Expeditionen. Da Hr. Svendsen, der var Expeditionens Kemiker det første Aar, havde af Helbredshensyn meldt Forfald, blev i hans Sted antaget Hr. H. Tornøe, der under Professor Waages personlige Ledelse havde arbejdet paa Laboratoriets Indredning siden den 23de Maj. For at vinde Tid besluttedes at gaa Accumulatorerne imøde til Stavanger, og her kom de ombord den 13de Juni, hvorefter Expeditionen strax gik tilsøs.

Omtrent 3 Mil SV. for Udsire toges en Temperaturrække, og Dagen efter en lignende tvers af Feje (60° 42′ N. Br.), hvorefter Kursen sattes direkte paa Station No. 96 (66° 9′ N. Br., 3° 0′ L. Ø. f. Gr.), der naaedes Kl. 6 Morgen den 16de Juni.

Ved at tage 54 Lodskud, 6 Skraber, 3 Trawler og 7 Temperaturrækker undersøgtes 3 Tversnit udenfor Kysten mellem Foldenfjord og Vestfjorden af tilsammen 115 g. Miles Længde. Det nordligste af disse Snit gik helt fra 67° 53′ N. Br. og 5° 12′ L. Ø. f. Gr. til hen imod Trænen (66½° N. Br. 12° L. Ø. f. Gr.). Efter at have taget en Temperaturrække i Vestfjorden, ankom Expeditionen

Botanical work, comprising collections of the flora, will, if possible, be prosecuted on Jan Mayen.

The meteorological observations on board will be made essentially as in 1876.

As in 1876, the S.S. "Vøringen" was on the 14th of April given up by her owners to the agent of the Expedition, and her nautical equipment again undertaken by Messrs Brunchorst and Dekke.

On the 19th of May the crew came on board, and on the 23rd, at 2 o'clock in the morning, the vessel left Bergen for Husø, where I purposed taking the preliminary observations indispensible for the subsequent use of the Fox-circle. But, on arriving at that island, a defect was discovered in the pin of the after-crank, and the weather, too, being very unfavourable for such observations, we returned at once to Bergen, and had a new shaft put in. This was got done by the 31st of May; but unfortunately the final departure of the Expedition had to be still further delayed. Mr. Macintosh, the London manufacturer, who was to have furnished new straps for the accumulators, having overlooked the order, and being in consequence unable to execute it before the 10th of June. During this interval a fresh but, owing to the boisterous weather at Husø, wholly abortive attempt was made to obtain the preliminary magnetical observations.

On the 11th of June Professors Mohn and Sars, Dr. Danielssen, Mr. Schiertz, artist, and Dr. Hansen, embarked in Bergen. Dr. Hansen, who was not a member of the Scientific Staff, having permission from the Home Department to proceed as passenger to Tromsø, where Mr. Friele was to join the Expedition. Mr. Svendsen, chemist to the Expedition on the first year's cruise, having by reason of ill-health been compelled to retire, Mr. H. Tornøe, who, since the 23rd of May, under the personal guidance of Professor Waage, had been at work fitting up the Chemical Laboratory, was engaged in his stead. Time being precious, we resolved on running south, to await in Stavanger the arrival of the new accumulators, which reached that place on the 13th of June; and having got them on board, the Expedition immediately put to sea.

About 12 miles south-west of Utsire we took a series of temperature-soundings, and on the following day another, off Feje (lat. 60° 42′ N.), after which the Expedition stood for Station 96 (lat. 66° 9′ N., long. 3° 0′ E.), arriving there on the 16th of June, at 6 o'clock in the morning.

Three transverse sections off the coast, between the Foldenfjord and the Vestfjord, measuring together 460 miles in extent, were now explored, by taking 54 soundings, 6 hauls of the dredge, 3 of the trawl, and 7 serial temperatures. The most northerly of these sections extended from a point in lat. 67° 53′ N. and long 5° 12′ E. to a point in the immediate vicinity of Trænen (lat.

den 23de Juni til Bodø, hvor Provisioner indtoges, og Kronometrenes Stand undersøgtes.

Den 25de Juni gik vi til Hopen i Saltenfjorden for at fylde Vand, og derfra om Natten over Vestfjorden til Røst, idet der paa Vejen toges en Række Lodskud. Ved Røst foretoges Deviationsprøve samt magnetiske og astronomiske Observationer i Land. Det viste sig imidlertid, at Stedet mod Formodning var uskikket til magnetisk Basis-Station, idet Declinationen kunde variere hele 7° paa to nærliggende Øer.

Om Middagen den 28de gik Expeditionen atter tilsøs mellem Røst og Værø, og i Løbet af to Dage opārbejdedes 3 Tversnit mellem Røst og Hadselfjorden, hvor vi løb ind Lørdagen den 30te Juni. Den paafølgende Søndag laa Expeditionen til Ankers i Sundet ved Sortland. Mandag Morgen gik vi atter tilsøs mellem Langø og Andø, og fandt Bankens Eg her meget nærmere Land end tidligere. Om Natten gik vi noget længere ind paa Banken, og her fiskedes fra Borde stor Torsk, Lange, Brosme og Kveite i betydelig Mængde med Haandsnøre. Den næste Dag, 4de Juli, fortsattes atter Rejsen udover i et længere Snit indtil 70° N. Br. og 6° 15′ L. Ø. f. Gr., paa hvilket Punkt der arbejdedes hele Dagen den 5te Juli i 1710 Favnes Dyb med Lodning, Temperaturrække, Skrabe og Trawl i et usædvanligt roligt og smukt Vejr. Herfra styredes igjen østover, under stadigt Arbejde paa en Række Stationer, til Malangenfjorden, hvis Munding passeredes om Formiddagen Søndag den 8de Juli. Samme Dags Middag ankrede Expeditionen i Tromsø.

Fra Røst af var taget 45 Lodskud, 5 Skraber, 5 Trawler og 8 Temperaturrækker. Ved denne Lodning opdagedes, at Atlanterhavs-Dybet eller Ishavsdybet her trænger ind i Banken, hvorved der dannes en Eg paa lignende Maade som ved Storeggen udenfor Romsdalskysten. Men denne nordlige Eg, som blev kaldt "Vesteraalseggen," har en ganske anden Udstrækning end Storeggen. Vesteraalseggen begynder omtrent 15 geogr. Mil retvisende Vest af Røst og strækker sig herfra nordøstover parallel med Lofotens Øgruppe i 10 til 11 Miles Afstand fra Land til Vest af Hadselø, hvor den bøjer mere østover ind mod Land. Ved Nordpynt af Langø er Kanten af Eggen ikke mere end 4 g. Mil fra Land. Den tager i Nord for Andenes og i Vest for Kvalø en mere nordlig Retning igjen, og paa 70½ Grads Bredde bøjer Isobatherne mere vestover, idet Affaldet af Banken antager en mere flaa Form. Vesteraalseggens Længde er saaledes omtrent 60 g. Mile og Bunden falder af mod NV. fra 100 til 1400 Favne paa en Distance af 5 Mil, hvilket, naar Talen er om Havbund, maa kaldes et stærkt Affald. Da de samme Fiske-

66½° N., long. 12° E.). After taking a series of temperatures in the Vestfjord, the Expedition stood for Bodø, reaching that place on the 23rd of June. Here we took in a supply of fresh provisons and got the chronometers rated.

On the 25th of June the "Vøringen" steamed up to Hopen, in the Salten Fjord, a good place for watering, and in the night stood across the Vestfjord to Røst, taking by the way a series of soundings. At Røst the ship was swung for deviation, and magnetical and astronomical observations were taken on shore. Contrary to expectation, this place proved wholly unsuited for a magnetical base-station, the declination on two adjacent islands varying as much as 7°.

On the 28th, about noon, the Expedition again put to sea, between Røst and Værø, and in the course of 2 days investigated 3 transverse sections, between Røst and the Hadselfjord, reaching the latter locality on Saturday the 30th of June. The next day being Sunday, the "Vøringen" lay at anchor in Sortland Sound. On Monday morning we again put to sea, between Langø and Andø, and struck the edge of the bank considerably nearer land than we had done in any other locality. After night-fall we steamed farther in shore, and took numbers of large cod, ling, torsk, or tusk, and halibut, fishing with hook and line from the ship's side. On the day following, the 4th of July, we pursued our outward course to a point in lat. 70° N., long. 6° 15′ E.; and here the Expedition passed the whole of the 5th, prosecuting exploratory work at a depth of 1710 fathoms, — sounding, dredging and trawling, and taking serial temperatures, in weather remarkably calm and fair. Again steering east, we kept on steadily, working at a number of stations, till we reached the Malangen Fjord, the mouth of which was passed on the forenoon of Sunday, the 8th of July. The same day, shortly after noon, the "Vøringen" dropped her anchor at Tromsø.

On our course from Røst we took 45 soundings, 5 hauls of the dredge, 5 of the trawl, and 8 serial temperatures. These soundings disclosed an important fact, viz. in showing that along this line the basin of the Arctic Ocean cuts deep into the bank, forming an edge, as at Stor-Eggen, off the coast of Romsdal. But this northern edge, to which we gave the name of "Vesteraals-Eggen," differs widely from the Stor-Eg in extent. The Vesteraals-Eg commences about 60 miles due west of Røst, stretching thence in a north-easterly direction, parallel to the Lofoten Islands, distant 40 or 44 miles from the coast, on to the west of Hadselø, where it makes a somewhat easterly landward bend. At the northern extremity of Langø, the edge is not more than 12 miles from land. North of Andenes and west of Kvalø, it again takes a more northerly direction, and in lat. 70° 30′ N. the isobaths bend more to the west, the slope of the bank being less sudden here. The length of the Vesteraals-Eg reaches accordingly about 240 miles, and the bottom shelves, in a north-westerly direction, over a distance of 20 miles, from 100 fathoms

sorter findes paa Vesteraalseggen som paa Storeggen, og da Bunden har en lignende Formation og er af samme Beskaffenhed, er der en høj Grad af Sandsynlighed for, at det samme Slags Fiskeri, der drives udenfor Kysten af Søndmør, ogsaa maatte kunne lønne sig udenfor Lofoten og Vesteraalen. Vesteraalseggen vil maaske være lettere at drive end Storeggen, idet der er kortere Udsejlads, gode Med paa Land, saaat man let kan tage op Fiskepladsen, og gode Havne i Nærheden.

I Tromsø blev Expeditionen liggende til den 14de Juli, Kjedlen rengjordes, Axelen i Indhivningsmaskinen omlagdes, der fyldtes Kul og Vand. Overlæge Hansen gik i Land, og Kjøbmand Friele embarkerede, men maatte atter flytte i Land efter et Par Dages Forløb, da han var saa uheldig at forvride sin Fod. Lieutenant Petersen flyttede ogsaa i Land, da han i flere Uger ikke havde befundet sig vel, og haabede ved et Ophold i Land at blive sat istand til senere at følge med Expeditionen paa Turen til Jan Mayen. Under Opholdet i Tromsø arbejdede Zoologerne med Skrabninger fra Baad, Dybvandsthermometrenes Nulpunkter undersøgtes, Kronometrenes Stand verificeredes og absolute magnetiske Iagttagelser erholdtes.

Da den første Halvdel af Juli Maaned allerede udløb, før Expeditionen kunde fortsætte sine Arbejder i Søen, besluttedes det først at tage under Arbejde Bankerne nordenfor Tromsø, og derpaa at foretage Rejsen til Jan Mayen, hvor man kunde vente at finde Havet mere isfrit i August Maaned.

Lørdag den 14de Juli besøgtes Kjosen i Ulfsfjorden og Kl. 2 Mandag Morgen gik Expeditionen herfra tilsøs nordover gjennem Fugløgabet. Der undersøgtes nu to Tversnit nordenfor Malangenfjord ved at tage 18 Lodskud, 3 Skraber, 1 Trawl og 3 Temperaturrækker. Ved disse Tversnit bestemtes ogsaa Vesteraalseggens nordre Ende. Under dette Arbejde var Vejret mindre gunstigt, vi havde østlig Kuling med adskillig Sø samt koldt Vejr og Taage, men ikke mere end at Arbejdet gik sin uforstyrrede Gang. Fredag den 20de kom vi atter tilbage til Tromsø, hvor baade Hr. Friele og Lieutenant Petersen kom ombord igjen, begge betydeligt restituerede.

Efterat Forsyningerne atter vare kompletterede, afgik Expeditionen igjen den 24de Juli, og med fuld Damp og alle Sejl i Træk for en frisk nordøstlig Vind sattes Kursen vestover. Efterat 680 Kvartmile var udsejlede, var paaværende Plads 70° 23′ N. Br. og 2° 30′ L. Ø. f. Gr., og her toges det første Lodskud paa 1760 Favne. Fra dette Sted loddedes med omtrent 48 Kvartmils Mellemrum videre vestover indtil Dybden begyndte at aftage til mindre end 1000 Favne, da Lodskuddene sattes tættere. Den 28de,

down to 1400, — a fall which, referring as it does to the sea-bed, must be regarded as rather rapid. The fish met with on the Vesteraals-Eg belonging to the same species as those frequenting the Stor-Eg, and moreover, the bottom in both localities being of a like nature and formation, there is every reason to believe that a fishery of the kind now flourishing off the coast of Søndmør might be successfully carried on off Lofoten and Vesteraalen. Nay, the Vesteraals-Eg will, perhaps, as regards facilities for fishing it, prove superior to the Stor-Eg: to begin with, the run from shore is considerably shorter; excellent landmarks, too, indicate the bearings of the fishing-grounds, and good harbours are within easy distance.

The "Vøringen" remained at Tromsø till the 14th of July. During our stay, her boilers were cleaned and examined and the shaft of the donkey-engine relaid; here, too, she coaled and watered. Dr. Hansen left the ship, and Mr. Friele embarked, but had to go on shore again after a couple of days, having had the misfortune to sprain his ankle. Lieutenant Petersen, too, who for some weeks past had been indisposed, took a lodging in the town, in the hope that a short residence on shore would recruit his health, and enable him to accompany the Expedition to Jan Mayen. The work done at Tromsø comprised dredging from a boat, determining the freezing-points of the deep-sea thermometers, verifying the errors of the chronometers, and performing absolute magnetical determinations.

The first half of July expiring before the Expedition could resume its investigations at sea, we determined to explore first the banks north of Tromsø, and then proceed to Jan Mayen; besides, the sea surrounding that island would in all probability be less encumbered with ice in the month of August.

On Saturday the 14th of July we steamed to Kjosen in the Ulfsfjord; and from here, on Monday, at 2 a.m., the Expedition put to sea, steering northward through the Fugløgab. We now investigated two transverse sections north of the Malangenfjord, taking 18 deep-sea soundings, 3 hauls of the dredge, 1 cast of the trawl, and 3 serial temperatures. In these sections was also determined the northern extremity of the Vesteraals-Eg. For this exploratory work we had anything but favourable weather; it was cold and foggy, and blowing hard from the east, with rather a heavy sea; no break, however, occurred in the investigations. On Friday the 20th of July the Expedition again arrived at Tromsø, where we were joined by Mr. Friele and Lieutenant Petersen, both gentlemen much benefitted by their brief sojourn there.

After taking in a few additional stores, the Expedition once more put to sea, on the 24th of July, standing westward, under full steam, and every sail drawing in a fresh north-easterly breeze. When the distance run had reached 680 miles, the ship's position was lat. 70° 23′ N., long. 2° 30′ E. Here the first sounding was taken, in 1760 fathoms. From this point, steering westward as before, we sounded at regular intervals of about 48 miles, till the depth had gradually diminished to less than 1000

da Skibet efter Bestikket nærmede sig Land, hvilket dog paa Grund af Taagen ikke kunde sees, blev Dybden atter over 1200 Favne, senere 1060 Favne og derpaa 654 Favne. Ikke en halv Time senere fik vi gjennem Taagen Øje paa en af de stejle Isbræer paa Østsiden af Jan Mayen, og da Taagen en Stund efter lettede sig noget op, kom ogsaa Øens Nordspidse tilsyne. Hvor vi stoppede, var Dybden 144 Favne. Pladsen blev nu bestemt, idet vi blev liggende med Loddet i Bund, først Afstanden fra Land ved Ekkoet af et Kanonskud, der tydelig lod sig iagttage, og dernæst Retningen ved Pejlinger af de synlige Pynter i Nord og Syd.

Da Søen stod paa Østsiden af Jan Mayen, besluttedes at sejle omkring Øen til Vestsiden. Vi tog da Loddet ind og stod nordover langs Kysten med de mange Isbræer, men i det samme Øjeblik vi var tvers af Nordpynten, lagde Taagen sig atter ned paa Havet og tog bort al Udsigt. Der var imidlertid nu Intet til Hinder for at gaa omkring til Vestsiden. Vi styrede først Nord, derpaa Vest, saa Sydvest og endelig Sydost, medens Havoverfladens Temperatur maaltes hvert femte Minut. Den holdt sig jevnlig over 3°, og gik kun en Gang ned til 2°.3 C. Af Is var intet Spor. Da vi efter Bestikket nærmede os Vestkysten, loddedes nogle Gange indtil endelig Taagen løftede sig igjen, saaat Strandpartierne blev synlige. Vi kunde saaledes vælge vor Ankerplads, og Kl. 11 om Aftenen faldt Ankeret paa 20 Favne Vand i Marie-Muss Bugten, hvor der, uagtet hele Havet staar paa, var saa roligt som i en indelukket Havn.

Den følgende Dag var Havet ligesaa roligt, men Taagen skjulte fremdeles alt undtagen de lavere Partier, og laa som et Tæppe over vore Hoveder i omtrent et Par hundrede Meters Højde. Strax om Morgenen blev der gjort Landgang paa Stranden søndenfor "Fugleberget," et ejendommelig formet og farvet Fjeld, Levningerne af et gammelt Krater, der springer noget frem søndenfor den paa denne Side af Øen værende Lagune. Der var forskjellige Partier iland hele Dagen, som gjorde botaniske og geologiske Iagttagelser, tog Skitser og gik paa Jagt efter Søfugl og Polarræve. Af de sidste blev skudt 3 Stykker.

Den 30te Juli foretoges Skrabninger fra Baad i Marie-Muss Bugten, men da det begyndte at blæse en Bris af nordvestlig Vind, blev Brændingerne paa Stranden snart saa store, at man ikke kunde komme iland. Over Middag tiltog Vindens Styrke, og Kl. 5 Eftm. lettede vi for at gaa om paa den anden Side af Øen. Under Letningen kom Solen frem et Øjeblik, der blev maalt et Par Højder af den, og strax efter rev Vinden en Aabning i Taagen, saa vi første Gang fik se Beerenberg, hvis blændende hvide,

fathoms, when the soundings were set closer. On the 28th, when by dead reckoning the vessel was nearing land, which, however, we could not see owing to fog, the depth had again increased to upwards of 1200 fathoms; it then fell off, the two next soundings giving respectively 1060 and 654 fathoms. Scarce half an hour later we caught sight through the fog of one of the beetling glaciers on the eastern shore of Jan Mayen, and shortly after, the fog lifting a little, the northern extremity of the island rose in view. The depth where we stopped the engine was 144 fathoms. Lying to, with the lead on the bottom, the position of the vessel was now determined, — viz. by computing the distance of the land, from the echo following the discharge of a cannon, which could be distinctly observed, and then by taking the bearings of the promontories visible in the north and south.

With the wind then blowing, the sea broke on the eastern shore of Jan Mayen, and we determined, therefore, on steaming round to the west side of the island. Accordingly, we hauled in the lead, and stood northward, coursing along the coast, with its numerous glaciers; but, at the very moment we were abreast of the northern extremity of the island, the fog dropped like a curtain, cutting off every glimpse of Jan Mayen from our view. Meanwhile, there was nothing to prevent us from steaming on to the western shore. First we steered north, then west, then south-west, and finally south-east, recording every five minutes the temperature of the surface-water. This, with one exception, when it sank to 2°.3 C., was everywhere registered above 3° C. Ice there was none. So soon as our reckoning showed us to be nearing the west coast of the island, we sounded at intervals, till the fog at length rose, disclosing the lower parts of the island. We could now look about us, and at 11 p.m. let go our anchor in 20 fathoms, in Mary Muss Bay, which, notwithstanding its exposed situation, was then as smooth as a mill-pond.

On the following day the sea was equally calm, but the dense fog, stretching like a blanket about a couple of hundred metres above our heads, shut out from view, as on the previous afternoon, all but a low-lying strip of shore. Early in the morning we landed, south of the "Fugleberg," or breeding-cliff, a rock of singular hue and formation, the remains of an ancient crater, jutting forward to the south of the lagoon that lies on this side of the island. Several exploring parties passed the day on shore, doing botanical and geological work, sketching the scenery, and shooting sea-fowl and Polar foxes. The number of foxes killed was three.

On the 30th of July we dredged the bottom from a boat in Mary Muss Bay; but a breeze springing up from the north-west, there was soon too much surf on the shore to admit of landing. Shortly after noon the wind began to freshen, and at 5 p.m. we weighed anchor, deeming it best to run back to the opposite side of the island. Whilst the ship was getting under weigh, the sun came out a moment, enabling us to obtain a couple of altitudes; and immediately after, through a sudden rent in the fog, we caught

solbelyste Top mod den dybe blaa Himmel var et ligesaa gribende som pragtfuldt Syn. Under Gangen rundt Øens nordre Del til Rækved-Bugten bestemtes de forskjellige synlige Pynters og Isbræers Beliggenhed ved Hjelp af Pejlinger og Vinkelmaalinger med Sextant. Ved Midnat ankredes i den store Rækved-Bugt udenfor Lagunen paa 12 Favne Vand en god Kvartmil VSV. af Egøen.

Paa denne Ankerplads blev vi liggende den følgende Dag. Brændingen var for stor til, at vi kunde føre nogen Instrumenter iland. Skyteppet laa fremdeles over Beerenberg og over Sydlandets Højder, men Solen trængte oftere gjennem, saaat der fra Skibsborde kunde faaes en længere Række Solhøjder. Om Eftermiddagen, efter et frugtesløst Forsøg paa at komme iland, bestemtes ved Vinkelmaalinger Retninger og indbyrdes Afstande mellem flere af de fremtrædende Punkter paa Østsiden og Fugleberget paa Vestsiden, hvis Top kunde sees over Øens laveste Del. Samme Dag toges Skitser af de synlige Partier af Øen, og arbejdedes paa grundt Vand af Zoologerne.

Onsdag den 1ste August erholdtes atter nogle Solhøjder fra Ankerpladsen om Formiddagen. Skydækket begyndte at løse sig over Øens nordlige Del, men laa fremdeles tungt over den sydlige. Havets Tilstand var den samme, som Dagen før. Vi lettede og stod udover paa Havet, loddede, tog Temperaturrækker og skrabede paa den af sort Sand og Ler bestaaende Havbund. Imidlertid blev Beerenberg efterhaanden befriet for Taagehyllet, og om Eftermiddagen havde vi Fjeldet ganske klart i hele sin Udstrækning. Paa Havet havde vi ofte sterke Hvirvelvinde, og paa Land saa vi dem hvirvle Egøens løse Tufsand højt i Vejret, et skuffende Billede af en vulkansk Eruption. Om Aftenen ankredes udenfor Lagunen et Par Kvartmil i Sydvest for den forrige Ankerplads.

Den 2den August var Brændingerne fremdeles hinderlige for Landgang. Vi lettede om Formiddagen og stod østover, ved hvilken Lejlighed Beerenbergs Højde blev bestemt ved udsejlet Distance og Vinkelmaalinger. Derefter skrabedes og loddedes, idet vi atter gik østenom og nordenom Øen. Beerenberg tilhyllede sig atter i sit Taageslør, og vi havde seet den for sidste Gang. Allerede 7 Kvartmil i Nordøst for Nordøstkap fandtes 1040 Favne. Derefter oploddedes et Snit mod Vest og senere Nordvest, i hvilket vi fik 1000 Favnes Dyb i omtrent 28 Kvartmils Afstand fra Land. Der viste sig heller ikke her nogen Is paa Havet, men Luftens Temperatur gik om Natten ned til $+ 0^{0}.1$. Da vi allerede østenfor Jan Mayen havde fundet Kuldegrader i Havet i et saa ringe Dyb som 20 Favne, og saaledes var komne ind i den grønlandske Polarstrøm,

our first glimpse of Beerenberg, with his dazzling, snow-clad summit, standing boldly out against the deep-blue northern sky — a truly grand and imposing spectacle. On our course round the northern shores of the island to the Great Wood-Bay, we determined the position of the glaciers and headlands then visible, by compass bearings and observations with the sextant. At midnight we came to anchor in the Great Wood-Bay, off the lagoon, in 12 fathoms, upwards of a mile west-south-west of the Egg-crater.

We lay at our anchorage the whole of the following day. There was too much surf to attempt conveying any instruments ashore. The canopy of clouds still extended over Beerenberg and the heights in the southern part of the island, — though not so dense but that the sun could occasionally pierce it; and hence we succeeded from our position on board the ship in obtaining a series of altitudes. In the afternoon, having made a fruitless attempt to land, we determined by trignometrical observations the bearings of several of the salient points on the east coast, and their respective distances from the Fugleberg on the western shore, the summit of that cliff being visible above the lowest parts of the island. Mr. Schiertz, artist to the Expedition, made sketches of the scenery then in view, and our naturalists dredged in shallow water.

On the forenoon of Wednesday the 1st of August we could again take a few altitudes of the sun. There was now a rent here and there in the cover of cloud over the northern parts of the island; but over the southern it still hung heavily. As on the day before, there was a considerable swell. Weighing anchor, we stood out to sea, sounding, taking serial temperatures, and dredging the bottom, which consisted of black sand and clay. Meanwhile, Beerenberg had begun to emerge from under his misty shroud; and in the afternoon the giant stood forth in all his grandeur. Off the coast, fierce eddying gusts (whirlwinds) repeatedly swept the surface of the ocean; and on shore, as could be plainly seen from the deck of the vessel, they whirled high into the air the loose tufaceous sand of the Egg-crater, presenting a striking resemblance to a volcanic eruption. In the evening we anchored off the lagoon, a couple of miles south-west of our last anchoring-place.

On the 2nd of August the surf still prevented our landing. Getting under weigh in the forenoon, we stood eastward, our first work being to measure the altitude of Beerenberg, by computing from the distance run and trignometrical observations. We then dredged and sounded, again coursing east and north of the island. Beerenberg once more retired within his misty covering, and we had seen him for the last time. At no greater distance than 7 miles north-east of the north-eastern extremity of the island, the depth was 1040 fathoms. We then explored a section bearing west and north-west, in which the depth reached 1000 fathoms, about 28 miles from land. No ice was met with here either in the sea; but the temperature of the atmosphere sank at night to $+ 0^{0}.1$. Having observed east of Jan Mayen at the trifling

havde vi ingen særlig Grund til at opsøge selve Isgrændsen, og sejlede derfor tilbage mod Jan Mayen, hvor vi om Morgenen den 3die August befandt os udenfor Marie-Muss Bugten. Vejret var meget taaget og Brændingerne forbød Landgang. Vi gik om Formiddagen langs Vestkysten sydvestover, tog enkelte Lodskud og Skitser, naar Taagen lettede. Ved Middag passeredes Sydkap og de syv Klipper, hvorpaa hele Jan Mayen forsvandt i Taagen. Der arbejdedes nu paa flere Stationer sydover til et Punkt omtrent midtvejs mellem Jan Mayen og Islands Banker (69° 2′ N. Br., 11° 26′ L. V. f. Gr.), hvor der var 1004 Favne. Her slukkedes af, og i stille og løj Bris drev vi med Polarstrømmen sydover, medens Fyrgangene rengjordes, hvilket Arbejde var færdigt om Eftermiddagen den 5te August, hvorefter Kursen sattes østover for at støde sammen med det før oparbejdede Snit fra Trænen. Under denne Del af Arbejdet fandtes vor største Dybde — 2005 Favne — paa 68° 21′ N. Br. og 2° 5′ L. V. f. Gr. Middag den 8de August naaedes det vestligste af de før tagne Lodskud, og den 10de om Morgenen passerede vi gjennem Moskenes-Strømmen, den berygtede Malstrøm, ind i Vestfjorden, der laa i det pragtfuldeste Vejr. Om Eftermiddagen toges omtrent 8 Kvartmil søndenfor Skraaven en Misvisnings- og Deviationsobservation, og om Aftenen ankredes i Ørsnes. Den næste Dag toges to Skrabninger i Vestfjorden, og om Aftenen Kl. 11 ankom Expeditionen til Bodø.

Her blev nu Kjedlen ordentligt efterseet og Skibet rengjort udenbords. Samtidig toges magnetiske og astronomiske Observationer i Land. Onsdag den 15de August gik vi ind til Hopen, hvor vi fyldte en Del Vand, og gik derfra paa stille Vande gjennem Saltstrømmen ind i Skjerstadfjorden, hvor der blev taget 3 Lodskud, en Temperaturrække og 2 Skraber, hvoraf den ene strax indenfor Strømmen viste et særdeles rigt Dyreliv. Vi laa tilankers en Dag ved Rognan i Saltdalen, hvor vi fyldte det manglende af Vandbeholdningen. Lørdag den 18de August toges atter en Temperaturrække i Vestfjorden, hvorefter Kursen sattes sydover. Kl. $10^1/_2$ Form. den 23de August ankom Expeditionen til Bergen, hvor Desarmeringen strax paabegyndtes, og Skibet blev overleveret Rederiet færdig til Fragtfart paa den i Kontrakten stipulerede Dag, den 7de September.

Der blev dette Aar ialt taget 160 Lodskud, 27 Skraber, 9 Trawler og 37 Temperaturrækker. Expeditionen

depth of 20 fathoms a temperature below 0°, and thus struck the Greenland Polar current, we had no call to push on in search of the Ice-barrier itself, and accordingly steamed back to Jan Mayen, reaching that island, off Mary Muss Bay, on the morning of the 3rd of August. The weather was exceedingly foggy, and the surf forbade all thoughts of landing. During the forenoon we coursed along the western shore in a south-westerly direction, took a few soundings, and made sketches of the coast whenever the fog cleared off. By noon we had reached South Cape, after passing which and the Seven Cliffs Jan Mayen suddenly disappeared, the whole island having been swallowed up, as it were, by the fog. We now took a southward course, investigating at several stations, to a point about midway between Jan Mayen and the Iceland banks (lat. 69° 2′ N., long. 11° 26′ W.), where the depth was 1004 fathoms. Here, we had the engine-fires put out, preparatory to clearing the stoke-holes: and now in a dead calm, now before a light breeze, the "Vøringen" drifted south with the Polar current. On the afternoon of the 5th she was again under steam, standing east for the Trænen section, already explored. In this part of the ocean we found the greatest depth measured on the Expedition — 2005 fathoms, in lat. 68° 21′ N. and long. 2° 5′ W. On Monday the 8th of August, about noon, we reached the point at which the most westerly sounding had been taken, and on the morning of the 10th steamed through Moskenes Sound, with its whirlpool of dread repute — the celebrated Malstrøm, into the Vestfjord, that lay extended before us, peacefully slumbering in the glorious summer weather. In the afternoon, about 8 miles south of Skraaven, observations were taken to determine the deviation of the compass, and in the evening we anchored at Ørsnes. On the following day the dredge was twice sent down in the Vestfjord, and in the evening the Expedition arrived at Bodø.

Here the boilers were carefully examined, and the outside of the vessel washed. Moreover, we took advantage of our stay at this place to take magnetical and astronomical observations on shore. On Wednesday the 15th of August the Expedition proceeded to Hopen, and took in there a supply of water, after which we steamed, with a slack tide, through Saltstrømmen Sound into the Skjerstadfjord. Here we took 3 soundings, 1 set of temperatures, and 2 hauls of the dredge, one of which, viz. that taken on entering the Sound, was uncommonly successful, bringing up a rich freight of animal life. We passed a day at Rognan in Saltdalen, to complete our supply of water. On Saturday the 28th of August, after taking another serial temperature in the Vestfjord, the Expedition stood south for Bergen, where we arrived on the 23rd of August, at 10 o'clock in the morning. After paying off the crew, the work of clearing the vessel and getting her ready for the freight-trade was at once commenced, and on the 7th of September, the day stipulated in the Contract, she was given up to her owners.

This year there were taken in all 160 soundings, 27 hauls of the dredge, 9 casts of the trawl, and 37 serial

havde hele denne Sommer et for de besøgte Farvande vistnok usædvanligt smukt Vejr, der ikke alene tillod, at der blev arbejdet paa saamange flere Stationer end den første Sommer, men Arbejdet paa hver enkelt Station blev udført med Ro og Lethed, og der var fuld Anledning for Zoologerne til strax at foretage de foreløbige og som oftest vigtigste Iagttagelser, hvilket det hyppigt det første Aar blev aldeles umuligt at udføre paa Grund af Skibets voldsomme Bevægelser.

1878.

Den for dette Aar vedtagne Plan, der ledsagedes af et Kart over de eventuelle Stationer, var saalydende:

Ved Expeditionens Rejser i 1876 og 1877 ere Undersøgelserne af det norske Hav i de Retninger, der ere Expeditionens Formaal, naaede til den 71de Breddegrad. Hvad der staar tilbage, er saaledes den nordenfor den nævnte Breddegrad liggende Del af det europæiske Ishav, der om Sommeren er navigabel uden Hindringer, foraarsagede ved Is.

Den Del af dette Hav, der ligger mellem Nordkap, Spidsbergen, Novaja-Semlja og Nord-Rusland — kaldet Østishavet, Novaja-Semlja-Havet eller det Murmanske Hav — vides ifølge Observationer fra Finmarkens Kyster og fra Havet søndenom og østenom Beeren-Eiland at være for hele den sydlige og vestlige Dels Vedkommende fyldt med Vand, der holder Varmegrader. Det synes at være fra dette Hav at Lodden, der giver Finmarken sit bekjendte Vaartorskfiske, kommer ind til den norske Kyst. Da Grændsen for begge disse Fiskearters Vandring antagelig er omtrent der, hvor det varme Vand ved Havbunden afløses af iskoldt Vand, maa det ansees for at være af stor Interesse at faa bestemt, i alle Fald i større Omrids, Beliggenheden af den Linie, der betegner Grændsen mellem det varme og det iskolde Vand ved Havbunden i Østishavet samt de øvrige fysiske og biologiske Forhold paa begge Sider af denne Grændse. Forholdene ere her i mange Henseender overensstemmende med dem paa Kystbankerne paa Norges Vestkyst, men vise ogsaa Forskjelligheder derfra og frembyde saaledes et Felt for Studiet af saavel Havstrømningernes Natur som af Dyrelivets Forhold, der er af høj Betydning for disses Forklaring i sin Almindelighed.

Til at lette denne Undersøgelse tjener for det første den Omstændighed, at Østishavet er forholdsvis grundt — de største Dybder naa ikke 300 Favne. Desuden er Nordgrændsen for det varme Vand ved Bunden paa en større

temperatures. Throughout the entire season the weather continued remarkably fine for the high latitudes in which the Expedition had to cruise; and this fortunate circumstance admitted not only of our extending the exploratory work to a greater number of observing-stations than the year before, — at every single station, this could in consequence be accomplished with precision and comparative facility; moreover, ample opportunity was afforded the zoologists of instituting on ship-board their preliminary and, as a rule, most important observations, which, on the preceding cruise, had so frequently proved impossible, owing to the violent motion of the vessel.

1878.

The Scheme approved for this year, to which had been appended a Diagram showing the position of each observing-station, ran as follows: —

As the result of its cruises in 1876 and 1877, the Expedition has investigated the Norwegian Sea in the several directions that had necessarily to be taken for the attainment of the object proposed, up to the 71st parallel of latitude. Hence, what remains to be explored is the tract of the Arctic Ocean in Europe stretching north of the said line, and which in the summer months may be navigated without impediment from ice.

The section of this ocean-basin lying between the North Cape, Spitzbergen, Novaja Zemlja, and Northern Russia — differently designated as the East Arctic Ocean, the Novaja Zemlja Sea, the Murman Sea, and the Barentz Sea — is known, from observations instituted on the coasts of Finmark and in the open sea south and east of Beeren Eiland, to be filled with water of a temperature above 0° throughout the southern and western tracts. It is from this sea, apparently, that the capelan, the little fish to which Finmark is indebted for her spring cod-fishery, repairs to the Norwegian coast. The boundary that marks the migratory distribution of these two fishes, lying, we have reason to believe, about where the warm and cold bottom-water meet, it is obviously of great importance to determine — if not in detail, at least broadly — the line bounding the warm and cold areas at the bottom of the East Arctic Ocean, together with the physical and biological conditions dominant on either side. The general conditions there have in many respects not a little in common with those of the coastal banks off the western shores of Norway; but, differing materially in some, they present, as regards the nature of ocean-currents and the conditions of animal life, a specially valuable field of elucidative research.

Exploratory work in this tract will be much facilitated by reason of the comparative shallowness of the East Arctic Ocean, — the greatest depths not even reaching 300 fathoms. Besides, the northern boundary of the warm

Strækning allerede bestemt, nemlig østenfor Beeren Eiland, og en ydre Grændse foreløbig kjendt mod Øst ved de talrige og udmerkede Observationer, som den østerrigske Polarfarer Løitn. Weyprecht har anstillet og velvilligen meddelte Professor Mohn til Afbenyttelse. Disse Omstændigheder tillade en saa vidt gaaende Orientering i Feltet, at man kan gjøre en Beregning over den Tid, Undersøgelserne ved Expeditionen antagelig ville komme til at tage. En saadan Beregning, hvis Resultat nedenfor skal meddeles, viser, at der for Tidens Skyld Intet er til Hinder mod at optage denne Undersøgelse af Østishavet inden Expeditionens Undersøgelseskreds.

Ved de sidste Expeditioner af Professor Nordenskiöld er det kariske Havs fysiske og biologiske Forhold blevne undersøgte. Vor Expeditions Undersøgelse af Østishavet vil knytte Undersøgelserne fra det hele Atlanterhav til dem, der ere gjorte og forhaabentlig til Sommeren af Nordenskiöld blive gjorte ved Kysterne af det asiatiske Ishav og dem, der ere gjorte i endnu nordligere Egne af den østerrigsk-ungarske Polar-Expedition.

I Forbindelse med Undersøgelserne af Østishavet er det ønskeligt at benytte Anledningen paa Rejsen langs Finmarkens Kyst til zoologiske Undersøgelser i nogle af de Fjorde, der hidtil ikke ere undersøgte af vore Zoologer, saasom Altenfjord, Porsangerfjord eller Laxefjord og Tanafjord. Endvidere er det af Vigtighed for de meterologiske Observationer, som udføres paa Expeditionen, at de nærmeste Stationer i Norge, med hvilke Observationerne fra Havet blive at sammenstille, inspiceres ved samme Lejlighed i Lighed med hvad der de foregaaende Aar har fundet Sted. Disse Stationer ere Alten (Bossekop) Gjesvær og Vardø, af hvilke i alle Fald den første og sidste ligge lige i den til de ovennævnte Undersøgelsers Udførelse førende Vej.

Undersøgelserne af Havet mellem Nordkap, Jan Mayen og Spidsbergen antages at burde foretages paa samme Maade, som man tidligere er gaaet frem paa, nemlig ved Tversnit der opgaaes nogenlunde lodret mod Kysterne. Da Havbroen mellem Norge og Spidsbergen og Spidsbergens Vestkyst gaar i en mere nordlig og vestlig Retning end Norges Kyst ved Tromsø, blive Tversnittenes Retning at lægge mere langs Parallelcirklerne end tidligere. En Overgang heri kan naturligst ske ved at lægge et Par mindre Snit mellem Beeren-Eiland og Norge i Vinkel med Toppunkt ude i Havet omtrent midt imellem to større Tversnit.

Indtil Beeren Eiland (75° N.) lægges de store Tversnit med samme indbyrdes Afstand som Snittene søndenfor fra 1877. Det sydligste af de nye Snit er Fortsættelsen vestover af det nordligste i 1877 oparbejdede Snit. Vest-

bottom-water has been already determined for a considerable distance, viz. east of Beeren Eiland; and we are furnished, provisionally, with an extreme eastern limit in the many and excellent observations taken by the Austrian Arctic traveller, Lieutenant Weyprecht, and which he has kindly placed at the disposal of Professor Mohn. These data suffice to give some little familiarity with the salient features of the section, and hence afford a means of approximately computing the probable duration of the period required for the proposed investigations. A calculation has accordingly been made, and with such results that, as regards time, there will be nothing that need exclude a scientific investigation of the Barentz Sea from the exploratory work of the Expedition.

On the latest Swedish Expeditions, the physical and biological conditions of the Kara Sea were investigated by Professor Nordenskiöld. The exploration of the Murman Sea by the Norwegian Expedition will connect the investigations embracing the whole of the Atlantic with those that have been, and next summer, there is reason to believe, will be, carried out by Nordenskiöld in the Arctic Ocean off the coasts of Asia, and those achieved in still higher latitudes by the Austrio-Hungarian Polar Expedition.

When coursing along the coast of Finmark to the Murman Sea, advantage shall be taken of the opportunity then afforded of prosecuting zoological work in divers of the fjords not yet investigated by our naturalists, for example the Altenfjord, the Porsanger or Laxefjord, and the Tanafjord. Moreover, it is important, as regards the meteorological observations of the Expedition, that the stations — at the nearest points on the Norwegian coast — with which the observations taken in the open sea will have to be compared, shall on that occasion be duly inspected, as on the two preceding cruises. The stations in question are Alten (Bossekop), Gjesvær, and Vardø, two of which, the first and the last, lie directly in the route of the Expedition to the aforesaid field of investigation.

For the exploration of the Sea extending between the North Cape, Jan Mayen, and Spitzbergen, the best system will, it is believed, be that previously adopted, viz. of laying transverse sections as nearly as may be perpendicular to the coast. The edge of the bank between Norway and Spitzbergen, as also the western shores of that island, extending more to the north and west than does the coast of Norway at Tromsø, the transverse sections will have to be given a position somewhat more concentric with the parallels of latitude than in the tracts previously explored. With this object in view, the most natural transition may be effected by laying at an angle, with the vertex seawards, a couple of smaller sections beween Beeren Eiland and Norway, about midway between two larger sections.

As far north as Beeren Eiland (lat. 75°), the large transverse sections will have to lie at the same distance each from each as those explored south of that locality on last year's cruise (1877). The most southerly of the new sec-

grændsen for disse Tversnit er Østgrændsen for Grønlandsisen, eller om denne skulde være usædvanlig langt tilbagetrukket mod Vest, en Linje, der tillader ved Lodskuddene at opnaa en sikker Kundskab om Havbundens Form i det Store og et nøjagtigt Studium af det her antagelig værende dyriske Protoplasma, som fandtes i 1877 ved Jan Mayen. Vestenfor Spidsbergen er Bundens Form i det Store taget nogenlunde kjendt efter de svenske Expeditioners Lodninger. Men da paa den Tid disse foretoges (1868) endnu intet paalideligt Dybvandsthermometer havdes og Skrabninger paa store Dyb med store Apparater ikke vare komne igang, vil det for vor Expeditions Øjemed være nødvendigt at gjennemgaa det hele Felt systematisk. Da Afstanden mellem Spidsbergens Vestkyst og Grønlandsisen aftager raskt mod Nord, blive Tversnittene her efterhaanden kortere og kunne derfor samtlige lægges helt over den nævnte Afstand med en indbyrdes Afstand af en god Breddegrad.

Paa Bankerne sættes Lodskud saa tæt, at disses Afheld mod Dybet bliver bestemt paa en utvetydig Maade. Ude i det store Ishavsdyb vil en Meridiangrad (60 Kvartmil) antagelig være en passende Afstand mellem Lodskuddene i samme Tversnit.

En Gjenstand for speciel Undersøgelse bliver den varme Atlanterhavs Strøms Løb og Udstrækning mellem Beeren Eiland og Spidsbergen. Denne Undersøgelse, der fordrer Rækker af tættere Lodskud med Temperaturrækker, lover at blive af overordentlig stor Betydning for Havstrømmenes Theori, da den varme Strøm her flyder nordover mellem 2 sydovergaaende Polarstrømme, Grønlandshavets i Vest og Østspidsbergen — Beeren Eiland's mod Øst.

Dersom Isforholdene tillade det, udstrækkes Undersøgelserne til Spidsbergens Nordkyst. Antagelig er her Polarstrømmen alene raadende og dermed en passende Grændse sat for Expeditionens Arbejder mod Nord.

At udstrække Rejsen saa langt ind i Polarstrømmen, som Isforholdene tillade, er af Vigtighed for Undersøgelsen af det i 1877 ved Jan Mayen fundne Protoplasma.

Undersøgelserne antages at burde deles i 3 Afdelinger, mellem hvilke anløbes nærmeste norsk Havn (Hammerfest) for Udrustning med Kul, Vand, Proviant etc. Turen til Øst-Ishavet antages at burde foretages først, da Isen her antagelig tidligere trækker sig tilbage end i Grønlandshavet. Turen til Spidsbergen lægges til August Maaned, der er den bedste Aarstid paa disse Kanter. Turen vesterud til Grønlandshavet nordenfor Jan Mayen bliver saaledes den 2den i Rækken.

tions will extend westward from the most northerly section investigated the year before. The western limit for these sections will coincide with the eastern boundary of the Greenland ice-barrier, or, in the event of that barrier having receded unusually far west, with a line allowing the contour of the sea-bed on the Greenland side to be broadly determined, and offering ample opportunity for a detailed study of the animal protoplasma met with in 1877 off the island of Jan Mayen, and believed to occcur also in this region. West of Spitzbergen, the contour of the bottom was broadly determined by soundings taken on the Swedish Expeditions. No trustworthy deep-sea thermometer having however at that time been devised (1868), nor dredgings essayed at great depths with apparatus of proportionate dimensions, the whole of the tract will need to be gone over anew and systematically investigated. The distance between the west coast of Spitzbergen and the Greenland ice-barrier rapidly diminishing towards the north, the transverse sections here will get gradually shorter, and may accordingly be laid right across, at intervals slightly exceeding one degree of latitude.

On the banks, the soundings shall be taken with sufficient frequence to admit of clearly determining the seaward incline. In the great Arctic basin, intervals of 60 miles, or one meridional degree, will, it is believed, be a suitable distance at which to sound in one and the same section.

A subject for special investigation will be the flow and extent of the warm Atlantic current between Beeren Eiland and Spitzbergen. The solution of the problem therein involved, which calls for series of closer soundings, together with serial temperatures, cannot but furnish highly important data bearing directly on the theory of ocean currents, the warm Atlantic water here flowing northwards between two southward-setting Polar currents, — a western through the Greenland Sea, and an eastern passing along the shores of East Spitzbergen and Beeren Eiland.

Provided the further course of the vessel be unobstructed by ice, the Expedition will extend its investigations to the North Coast of Spitzbergen. In this region, probably, the Polar current alone prevails, and may, therefore, be taken as a proper boundary for the northern field of exploratory research.

By pushing on as far as practicable into the Polar current, i. e. till ice shall bar farther progress, much valuable material may be collected for prosecuting the investigation of the protoplasma found in 1877 off the island of Jan Mayen.

The exploratory work to be done on each cruise should, it is opined, embrace three intervals, or periods, the Expedition making, so soon as the investigations allotted to each shall have been completed, for the nearest Norwegian port (Hammerfest), to refit the vessel, taking in there a supply of coal, water, provisions, &c. The Murman Sea should, it is believed, be the first region explored, the ice there most probably breaking up somewhat earlier in the season than is the case with that of the Greenland Sea. The trip to Spitzbergen will be deferred till August, gener-

Expeditionen antages at afgaa fra Bergen i Midten af Juni til Tromsø. Forsaavidt Rejsen sker gjennem Vestfjorden, kunde Lejligheden benyttes til at tage en Temperaturrække i det dybeste af Vestfjorden udenfor Tranø, hvor de nye Dybvandsthermometre kunde prøves. Turen til Tromsø antages at kræve 4 Døgn. I Tromsø standses for at tage ombord en Mand, der medfølger Expeditionen som Kjendtmand for Finmarkens Kyst, Beeren Eiland og Spidsbergen. Derpaa gaar man ind til Alten, hvor den meteorologiske Station inspiceres, og Skrabning (Trawl) udføres i Altenfjorden. Herfra til Hammerfest, hvor Expeditionen indtager Forsyninger for Øst-Ishavsturen. Magnetiske Observationer til Bestemmelse af Misvisningen og Kompassets Deviation foretages i Altenfjord eller ved Hammerfest.

Fra Hammerfest sejles til Porsangerfjorden, hvor der loddes, tages Temperaturrækker og skrabes. Herfra, om Vejret (Taage) ikke er til Hinder, ind i Tanafjorden, hvor de samme Arbejder udføres. Derfra til Vardø, hvor den meteorologiske Station inspiceres.

Fra Vardø styres (omkring 27de Juni) først østover, derpaa nordover til Beeren Eilands Parallel og derpaa vestover, og Linjen for 0° ved Havbunden bestemmes. Ere Omstændighederne gunstige, forsøges Landgang paa Beeren Eiland. Herfra opsejles 2 Tversnit over Banken mellem Beeren Eiland og Norge for at bestemme dens Afheld mod Ishavsdybet, og derpaa sejles til Hammerfest, idet et Par Stationer lægges paa Vejen. Med en Fart af 6 Mil i Vagten, 16 Loddestationer (15 med Temperaturrække, 13 med Skrabe (Trawl)) vil Turen fra Vardø til Hammerfest (efter den Tid som Erfaringen fra 1877 har vist at der medgaar til de forskjellige Arbejder paa forskjelligt Dyb) tage 11 til 12 Døgn. I Hammerfest gjøres klar til 2den Tur vestover. Afgangen derfra kan sættes til omkring den 11te til 12te Juli.

2den Tur beregnes med 6 Knobs Fart, 18 Stationer (17 Temperaturrækker, hvoraf mange ganske korte i Polarstrømmen, 6 Skraber paa Banken, 2 Skraber paa stort Dyb — Lodning, Skrabe og Temperaturrække à 17 Timer) til $12^1/_2$ Døgn. Paa Udrejsen fra Hammerfest undersøges Temperaturforholdene i Dybet omkring Station 201 fra 1877, hvor der viste sig et paafaldende anomalt Forhold.

ally the finest month in the year in those latitudes. Hence, the run westward and subsequent investigation of the Greenland Sea north of Jan Mayen, will occupy the second of the three intervals, or periods, planned in this Scheme of Work.

By the middle of June the Expedition will, if possible leave Bergen for Tromsø. Should the route selected lead through the Vestfjord, a series of temperatures might be taken in the deepest parts of the fjord, off Tranø, and the new deep-sea thermometers tested. Four days will probably be sufficient for the passage north to Tromsø. At this port the Expedition will take on board a pilot for the coast of Finmark, Beeren Eiland, and Spitzbergen. The next place on the route is Alten, where the Meteorological Station will be inspected, and the fjord dredged and trawled. From here the Expedition courses on to Hammerfest, at which port stores will have to be shipped for the exploratory tour to the Murman Sea. Magnetical observations to determine the deviation of the compass shall be taken either at Hammerfest or in the Altenfjord.

From Hammerfest the course runs on to the Porsangerfjord, where soundings and serial temperatures will be taken, and the dredge and trawl worked. From this point, weather permitting (it is frequently foggy hereabouts), the Expedition will steam on to the Tanafjord, and there prosecute similar exploratory work. The next place to be touched at is Vardø, where the Meteorological Station will be inspected.

From Vardø the Expedition will first stand eastward (about the 27th of June), then northward for the Beeren Eiland parallel of latitude, and then westward, determining by the way the boundary of the glacial bottom-area. If anyway practicable, the Scientific Staff will land on Beeren Eiland. From this point the Expedition shall explore a couple of transverse sections on the bank between Beeren Eiland and Norway, with the object of determining its incline towards the depths of the Arctic Ocean, and then run back to Hammerfest, working at one or two stations by the way. Steaming at the rate of 6 miles an hour, and with 16 sounding-stations, at 15 of which serial temperatnres will have to be taken and at 13 dredging and trawling-work done, the passage back to Hammerfest *viâ* Vardø (judging from last year's experience as to the time required for the different investigations at various depths) can be made in 11 or 12 days. At Hammerfest the vessel has to be got ready for the second of the cruises westward, the departure of the Expedition being fixed for about the 11th or 12th of July.

The speed of the vessel being supposed to average 6 knots, this second cruise will, with 18 stations (17 serial temperatures — many of those in the Polar current being however quite short — 6 hauls of the dredge on the bank, and 2 at great depths [sounding, dredging, and taking temperatures estimated to occupy 17 hours]), take 12 days and a half. On the run out from Hammerfest, the Expedition shall investigate the thermal conditions prevailing in deep water round Station 201, where, on last

Efter færdig Ekvipering i Hammerfest til Spidsbergensturen (antagelig omkring den 29de Juli) sejles til Farvandet mellem Beeren Eiland og Spidsbergen, hvilket antages at kunne undersøges tilstrækkeligt ved 3 Tversnit. Fra Sydkap sejles vestover til Grønlandsisen, nordover langs Isgrændsen og derpaa østover mod Mundingen af Isfjorden. Det næste Tversnit tænkes lagt vestover fra Kingsbay til Isgrændsen og det sidste store Tversnit lidt nordenfor 80° Bredde. Den her nævnte Del af Turen med 27 Stationer (25 Temperaturrækker, hvoraf flere smaa, 11 Skrabninger) samt Tilbagerejse til Hammerfest beregnes med 6 Mils Fart til 13½ Døgn.

Paa Optur søges Arbejdet paa Søen først fremmet med den Hurtighed som Undersøgelsernes Nøjagtighed kræver og Vejrforholdene tillade. Ere de sidste gunstige, anvendes de følgende Dage til mere specielle Undersøgelser paa Spidsbergens Banker, i dens Fjorde, i Land. Under tidligere indtræffende ugunstige Vejrforhold, tages de sidstnævnte Arbejder i Mellemtiden, om muligt, og Arbejderne i Søen under de gunstigere Perioder. Tilbagerejsen tiltrædes omkring den 24de August og gaar til Hammerfest eller (nærmere) til Tromsø, hvor den kjendte Mand sættes af. Herfra til Bergen, hvor Expeditionens derboende Deltagere gaa fra Borde, hvorpaa Rejsen fortsættes til Christiania og Horten, hvor Desarmeringen finder Sted, og Fartøjet gjøres istand til Overleverelse til Rederiet.

De videnskabelige Arbejder udføres væsentlig paa samme Maade som i 1877.

Ved Lodningerne og Temperaturrækkerne søges erholdt saamange fuldstændige Sammenligninger mellem de forskjellige Slags Dybvandsthermometre, som Omstændighederne tillade. En nøjagtig Undersøgelse af de ved de to første Togter benyttede Dybvandsthermometre ved Sammenligning med nyere Sorter er af største Vigtighed for den nøjagtige Bestemmelse af Temperaturen i Dybet paa de af Expeditionen i 1876 og 77 besøgte Strækninger. Bundprøve tages ved hvert Lodskud og opbevares. Temperaturrækkerne tages saa tæt, at en utvetydig Kundskab erholdes om Varmefordelingen i Dybet. I Polarstrømmen kunne de fleste Temperaturrækker indskrænkes til de øverste Vandlag (til — 1°), idet et Par fuldstændige Rækker tages gjennem hele Dybet til Constatering af Temperaturforholdene. Strømmaalinger forsøges. Ligeledes tages om muligt ved hvert Lodskud og paa enkelte Stationer, hvor det ansees ønskeligt, i intermediære Dybder Vandprøver til Bestemmetse af specifisk Vægt og chemisk Undersøgelse. Et Piezometer bør medfølge hvert Lodskud, dels som Control for Dybden dels til Bestemmelse af Piezometrets Constanter.

year's cruise, a singular anomaly of temperature was observed.

Having refitted at Hammerfest (by about the 29th of July) for the excursion to Spitzbergen, the Expedition shall at once proceed to the tract between Beeren Eiland and Spitzbergen, for investigating which three transverse sections will probably prove sufficient. From South Cape the course will lie westward to the Greenland ice, then northward along the ice-barrier, and then eastward for the mouth of the Ice-Sound. The next transverse section should, it is opined, stretch westward from King's Bay to the ice-barrier, and the last of the large transverse sections lie north of the 80th parallel of latitude. This third part of the entire cruise, with 27 Stations (25 serial temperatures, several of them short, and 11 hauls of the dredge), including the run back to Hammerfest, is calculated, with a speed of 6 knots, to take 13 days and a half.

On the passage out, all deep-sea work shall be done first, as expeditiously as may prove consistent with accurate investigation and the state of the weather. Provided the latter be favourable, some few days may then be devoted to more special investigations on the banks of Spitzbergen, in the fjords of the island, and on shore. Bad weather supervening, the exploration of the depths shall be broken off, to be resumed under more favourable circumstances, and the work on the banks prosecuted, if possible, in the interim. On the homeward passage — to commence about the 24th of August — the Expedition will make for Hammerfest, or possibly a nearer point, Tromsø, where the pilot will quit the ship. From here the homeward course runs straight to Bergen, where the members of the Scientific Staff resident in that city disembark, after which the vessel will proceed to Christiania and Horten. At Horten she will be paid off, and put in order previous to being given up to her owners in Bergen.

The scientific work of the Expedition to be prosecuted essentially as in 1877.

When taking soundings and serial temperatures, the various kinds of deep-sea thermometers shall be compared together as closely and as frequently as circumstances may admit of. A rigorous testing of the deep-sea thermometers employed on the two first cruises, by comparing them with those of a later construction, is of the utmost importance as regards the true determination of the temperature in the deeper strata of the ocean-tracts then visited by the Expedition. A sample of the bottom shall be brought up at every sounding, and preserved, for subsequent examination. The serial temperatures shall be taken sufficiently close to afford a clear insight into the thermal conditions throughout the ocean-depths. In the Polar current, most of the serial temperatures may be confined to the upper strata (to — 1°), two complete series being taken throughout the entire depth, to substantiate the nature of the thermal conditions. Observations are, if possible, to be taken for ascertaining the rate and direction of currents. Moreover, with every sounding, and at some stations from intermediate depths, a sample of the sea-water shall, if

Arbejde med Skrabe, Trawl, Svabere og Overfladenet foretages paa de Stationer, hvor saadanne ansees nødvendige for Studiet af Dyrelivet i de forskjellige Dybder, undersøiske Klimater og Bundarter.

De chemiske Arbejder, inclusive Bestemmelsen af Havvandets specifiske Vægt udføres i det væsentlige som i 1877.

Magnetiske Observationer søges udført i Søen, navnlig Misvisnings-Observationer. Absolute Bestemmelser af de jordmagnetiske Elementer søges gjort paa Land paa Spidsbergen, Beeren Eiland og i Norge. Saavidt muligt paa Steder, hvorfra der tidligere haves saadanne.

Geologiske og botaniske Iagttagelser udføres efter Lejlighed paa de Steder, som Expeditionen anløber. Ligesaa astronomiske Stedbestemmelser, topografiske og hydrografiske Undersøgelser.

De meteorologiske Iagttagelser ombord udføres som i 1877.

Ved de Lejligheder, Expeditionen passerer Beeren Eiland, forsøges, om Omstændighederne maatte være gunstige, Landgang der til Udførelse af astronomiske, geografiske, geologiske, zoologiske, botaniske, hydrografiske Undersøgelser.

Paa Spidsbergen foretages lignende Undersøgelser paa de Steder, hvor Expeditionen kommer til at anløbe — hvilke Steder blive at bestemme efter de Fordringer, som Arbejderne i Søen stille. Specielt haves Opmærksomheden rettet paa Undersøgelse af Fiskerierne ved Spidsbergens Kyst og i dens Fjorde, paa jordmagnetiske og hydrografiske Undersøgelser.

possible, be collected, for determining the specific gravity, and for chemical examination. A piezometer will have to be sent down with every sounding, partly as a means of controlling the depth, and partly to determine the constants of the piezometer.

Exploratory work with the dredge, trawl, surface-net, and swabs, will be prosecuted at all stations where it affords opportunity of investigating the forms of animal life in the various depths, as also submarine climatic conditions, and the materials of the sea-bottom.

The chemical work of the Expedition, including determinations of specific gravity, to be done essentially as on last year's cruise.

Magnetical observations shall, if possible, be taken at sea, in particular those for obtaining the variation of the compass, and absolute determinations ashore, on Spitzbergen, Beeren Eiland, and in Norway, if practicable at points from which such observations already exist.

Geological and botanical work will be prosecuted in suitable localities; likewise astronomical observations of latitude and longitude, together with topographical and hydrographical investigations.

The meteorological observations to be taken essentially as on last year's cruise.

When passing Beeren Eiland, attempt shall, on each occasion, if practicable, be made to land there, with the object of prosecuting astronomical, geographical, geological, zoological, botanical, hydrographical investigations.

On Spitzbergen, too, like investigations shall be undertaken in localities visited by the Expedition, the number and positions of the localities depending on the time required for the exploration in the open sea. Attention is specially directed to the fisheries off the coasts of Spitzbergen and in the fjords of the island, as also to the importance of magnetic and hydrographical observations.

Som Følge af, at Expeditionen for dette Aar var besluttet forlagt 14 Dage senere end de foregaaende Aars, indførtes de nødvendige Forandringer i Kontrakten om Lejen af Skibet, og dette overtoges først den 1ste Maj. Indredningsarbejderne udførtes ved Brunchorst & Dekkes Værft aldeles som det foregaaende Aar, uden Forandring hverken i Apteringer eller i Apparaternes Placering.

Den 11te Juni hejstes Kommandoen og Mandskabet paamønstredes. Da Premierlieutenant Petersen havde frasagt sig Posten som Næstcommanderende paa Grund af Sygdom, blev denne Stilling overtaget af Skibsfører Grieg, medens en tredie Styrmand forhyredes, for om muligt at overtage noget af Trediecommanderendes Tjeneste. Den 13de Juni kom Professor Sars og Kemikerne Tornøe og Schmelck ombord, og den 14de halede vi ud fra Værftet

The departure of the Expedition this year having been fixed to take place a fortnight later than on the two preceding cruises, a clause to that effect, modifying the terms originally agreed upon, was introduced into the Contract for the hire of the vessel; and accordingly she was not taken in charge till the 1st of May. This year, too, the ship was fitted out by Messrs. Brunchorst & Dekke, without change either as regards the general arrangement or the placing of the apparatus.

On the 11th of June I hoisted my pennant, and the crew came on board. Lieutenant Petersen, R.N., having from ill-health had to resign his post as first-lieutenant, Mr. Grieg, captain in the merchant-navy, was appointed to succeed him, and a third mate engaged to assist the first-lieutenant in the discharge of his duties. On the 13th of June Professor Sars embarked, along with Mr. Tornøe and Mr. Schmelck; and on the 14th we hauled out

og gik Prøvetur, under hvilken Loggemaskinen prøvedes og Kompassets Deviation undersøgtes. Lørdag den 15de kom D'Hrr. Mohn, Danielssen, Friele og Schiertz ombord og Kl. $4^3/_4$ samme Dags Eftermiddag afgik Expeditionen fra Bergen og styrede nordover langs Leden.

Mandag den 17de Juni, efter Afgangen fra Børøsund ved Throndhjemsleden havde vi det Uheld, at Skibet, omtrent tvers af Nordpynten af Fjeldvær, skurede over en Boe, og jeg saa, at en Del af Straakjølen gik tabt. Skibet blev ikke staaende, og heller ikke lækt, saa at der var stor Sandsynlighed for, at det ikke havde faaet nogen væsentlig Skade. Da der ikke existerer nyere, detaljerede Karter over denne Del af Kysten, var jeg her afskaaret fra Lejlighed til at kunne kontrollere Lodsen. Et Par Timer efter var vi saa heldige at træffe Havnevæsenets Dampskib "Nicolay," hvor Havnedirectør Roll med sin Dykker var ombord, og strax var villig til at yde fornøden Bistand. Begge Skibe gik da ind i Hopen-Fjord, hvor Dykkeren tre Gange var nede og undersøgte Vøringens Bund. Da han erklærede, at Skibet ingen anden Skade havde faaet, end det før nævnte Tab af en Del af Straakjølen, fortsattes Rejsen om Natten nordover. Under hele vor Rejse mærkedes ingensinde nogensomhelst Ulempe efter Stødningen, men ved Doksætningen om Høsten viste det sig, at selve Kjølen ogsaa for en Del var beskadiget, saaledes at Veritas-Besigtigelsen fordrede et Stykke ny Kjøl indsat.

Onsdag den 19de Juli toges en Temperaturrække og en Skrabe i Vestfjorden og Kl. 11 Form. den 20de ankom vi til Tromsø, hvor Kjendtmand Petter Bjørvik kom ombord. Denne Mand var gjennem velvillig Assistance af Hr. Toldkasserer Pettersen bleven engageret til at følge Expeditionen som Lods paa Finmarken og Spidsbergen. Kl. 4 samme Dags Eftermiddag afgik Expeditionen til Alten-Fjord, hvor der den 21de toges to Temperaturrækker, Skrabe og Trawl, medens Hr. Friele arbejdede langs Landet fra Baad og Professor Mohn inspicerede Altens meteorologiske Station. Kl. $5^1/_2$ Form. den 22de Juni ankredes i Hammerfest, hvor vi fyldte Vand og blev liggende Søndagen over. Kl. 2 Form. Mandag den 24de afgik vi fra Hammerfest, og arbejdede de følgende Dage i Porsanger-Fjord og i Tana-Fjord. Udenfor Baads-Fjord toges Misvisnings- og Deviations-Observation og den 25de Kl. $11^1/_2$ Eftm. ankom Expeditionen til Vardø. Efterat her var taget magnetiske og astronomiske Observationer og den meteorologiske Station inspiceret, gik vi tilsøs om Morgenen den 27de for efter Planen at begynde med Undersøgelserne i Øst-Ishavet.

from the wharf to take a trial-trip, during which the log-apparatus was tested and the deviation of the compass determined. On Saturday the 15th of June Professor Mohn, Dr. Danielssen, Mr. Friele, and Mr. Schiertz came on board; and on the afternoon of that day, at 4.45 p.m., the Expedition left Bergen, proceeding northward by the inshore route.

On Monday the 17th of June, shortly after our departure from Børøsund, a place on the inshore route to Throndhjem, the vessel chanced unfortunately to touch a sunken rock, and I saw part of the false keel carried away. Meanwhile, as the ship neither stuck fast nor sprang a leak, there was good reason to believe she could not have sustained any material damage. New, detailed charts for this part of the coast having not yet been constructed, I was unable to check the pilot. A couple of hours or so after our misadventure, we had the good fortune to fall in with the steamer "Nicolay," belonging to the Harbour Works; and Mr. Roll, the director, who happened to be on board and had with him his diving-assistant, at once volunteered assistance. Both vessels now steamed into the Hopen Fjord; and here Mr. Roll's diver went down three times in succession to examine the "Vøringen"'s bottom. His report, however, being to the effect that, beyond the aforesaid loss of part of her false keel, the ship had sustained no damage whatever, we resolved to continue the voyage, and after night-fall pursued our course northward. During the whole cruise no detrimental effects were found to result from the accident; but on docking the vessel in the autumn after our return, it seemed that the true keel had suffered to some extent too; indeed the Surveyor to the "Veritas" insisted on having a new piece put in.

On Wednesday the 19th of July a serial temperature and a haul of the dredge were taken in the Vestfjord; and on the forenoon of the 20th, at 11 a.m., we arrived at Tromsø, where a pilot, Petter Bjørvik by name, came on board. This man had been engaged by Mr. Pettersen, receiver of customs, to act as pilot to the Expedition for the coasts of Finmark and Spitzbergen. The same day, at 4 o'clock in the afternoon, the Expedition proceeded to the Alten Fjord, where, on the 21st, two serial temperatures were taken, together with a haul of the deep-sea apparatus, both dredge and trawl, Mr. Friele working the while along the shore from a boat, and Professor Mohn being occupied with inspecting the Meteorological Station at Alten. On the forenoon of the 22nd the Expedition arrived at Hammerfest, where we took in a supply of water, and spent the following day (Sunday) at anchor. On Monday the 24th of June, at 2 a.m., the Expedition left Hammerfest, and devoted the next few days to exploratory work in the Porsanger and Tana Fjords. Off the mouth of the fjord observations were taken to determine the variation and deviation of the compass, and on the 25th, at 11.30 p.m., the Expedition reached Vardø. After a series of magnetical and astronomical observations had been taken, and the Meteorological Station inspected, on the morning

Kursen sattes først i øst-nord-østlig Retning og samme Dag toges Trawl og Skrabe, samt tre Lodskud, men om Aftenen begyndte det at kule paa, og om Natten maatte vi lægge paa Vejret og blev liggende for Storm af VNV., Regn og noget Snedrev samt høj Sø til næste Dags Aften den 28de, da vi loddede og atter styrede øst-nord-østover. Der arbejdedes nu under stadig Kuling, surt og koldt Vejr først nordover til Beeren-Eilands Parallelcirkel og derefter vestover, indtil vi om Aftenen den 3die Juli fik Beeren Eiland i Sigte, og vi saa da den første Drivis, dog kun enkelte Flager. Om Formiddagen den 4de Juli ankrede vi under Beeren-Eiland udenfor den saakaldte Sydhavn,. og landsatte den til den hollandske Expedition med Skonnerten "De Willem Barendsz" fra Bergen medtagne Post, der nedgravedes i Nærheden af Russestuen og merkedes paa den af den hollandske Konsul opgivne Maade. Samtidig blev der skudt en Del Fugle og foretaget botaniske og geologiske Indsamlinger. Højden af Mount Misery bestemtes ved Vinkelmaalinger. Om Eftermiddagen afgik vi fra Beeren-Eiland og arbejdede sydvestover for at bestemme Affaldet af Banken mod Vest. Kl. $5^1/_2$ Form. den 6te Juli fik vi 1024 Favne paa 73° 6′ N. Br. og 11° 56′ L. Ø. f. Gr., hvorefter Kursen sattes øst-syd-østlig for at bestemme Affaldet paa en sydligere Bredde, og Kl. 2 Eftermiddag Mandag den 8de Juli ankom vi til Hammerfest.

Fra Tirsdag Morgen til Fredag Aften benyttedes Tiden til at skrubbe Skibsbunden, fylde Kul og Vand, rengjøre Kjedlen og efterse Maskinen, samt til at tage magnetiske og astronomiske Observationer, der udførtes paa Fuglenes i Nærheden af Gradmaalingsstøtten.

Kl. 6 Formiddag den 13de Juli afgik vi i godt Vejr paa den anden Tur og satte Kursen vestover. Om Eftermiddagen toges en Misvisningsobservation med Azimuther Kompasset rundt. Med vest-nord-vestlig Kurs naaedes den næste Dags Middag vort nordligste Punkt fra det foregaaende Aar, hvor der toges Lodskud og Bundtemperatur med 4 Thermometre af forskjellig Konstruktion. Herfra sejledes videre mod Vest-Nord-Vest, under jevnt Arbejde med Lodskud, Temperaturrækker og Trawl, indtil vi Onsdag Aften den 17de mødte de første Flager af den grønlandske Vest-Is og Kl. $10^1/_4$ maatte vi stoppe for tættere Drivis. Vi var da paa 73° 10′ N. Br. og 3° 22′ L. V. f. Gr., og havde saaledes mødt Isen paa en ikke lidet østligere Længde end paaregnet. Vejret var blevet koldt og taaget med en stiv Kuling af nordvestlig Vind. Efterat der var taget en Temperaturrække i Nærheden af Isen, sattes Kursen nordøstover og senere nordover langs Isen, der snart tabtes af

of the 27th of June we steamed out of the harbour, on the morning of the 27th of June, *en route* for the Barentz Sea, where, according to the Scheme of Work, the Expedition was now to commence investigations.

Our course lay first east-north-east, and the same day we dredged and trawled and took three soundings; but in the evening it came on to blow, and in the night we lay to, and rode out a gale from the west-north-west, with rain and snow and a heavy sea, till the evening of the following day, the 28th; we were then able to sound, after which we steamed on again, steering as before east-north-east. We now pushed on, in cold and boisterous weather, first northward as for as the Beeren Eiland parallel of latitude, and then westward till, on the evening of the 3rd of July, that island hove in sight, and we passed the first drift-ice, — however only a few isolated floes. On the forenoon of the 4th we anchored off South Harbour, as it is called, and sent ashore the letter-box we had brought from Bergen for the Dutch Expedition with the schooner "De Willem Barendsz;" this we buried near the Russian Hut, after marking it in the manner indicated by the Dutch consul. While some of the party were thus engaged, others roamed about, shooting birds and collecting botanical and geological specimens. The altitude of Mount Misery was determined by trignometrical observations. In the afternoon we left Beeren Eiland, steering south-west to determine the slope of the bank in a westerly direction. On the 6th of July, at 5.30 a.m., we sounded in 1024 fathoms, lat. 73° 6′ N., long. 11° 56′ E., after which the course of the vessel was changed to east-south-east, with the object of determining the slope farther south; and on Monday the 8th of July, at 2 o'clock in the afternoon, the Expedition arrived at Hammerfest.

From Tuesday morning til Friday evening the time was occupied with scrubbing the ship's bottom, taking in coal and water, cleaning the boilers, and examining the engine, as also with taking magnetical and astronomical observations, at Fuglenes, near by the column indicating the terminus of the Russian-Swedish-Norwegian arc of meridian.

On the 13th of July, at 6 a.m., we left Hammerfest, in fine weather, standing west on the second excursion of the cruise. In the afternoon observations were taken to determine the variation of the compass. Steaming west-north-west, by next day at noon we had reached the most northerly point of last year's cruise. Here soundings were taken, and the bottom-temperature registered with 4 thermometers of different construction. From this point we continued to steer west-north-west, taking soundings and serial temperatures and working the trawl, till on the evening of Wednesday the 17th of July we reached the first floes of the Greenland ice, and at 10.15 p.m. the engines had to be stopped, owing to the closer packing of the drift-ice. We were then in lat. 73° 10′ N. and long. 3° 22′ W., having struck the ice considerably farther east than anticipated. The weather had now turned cold and foggy, with a stiff breeze from the north-west. After taking a series

Sigte, men hvis Nærhed tilkjendegaves af den lave Temperatur. Fremdeles herskede ogsaa Taage, Kuling og Sø. Fredag Morgen den 19de havde vi naaet 75° 16′ N. Br. 0° 54′ L. V. f. Gr. og fik her dette Aars dybeste Lodskud med 1985 eng. Favne, hvorefter Kursen sattes østover langs den 75de Breddegrad. Ved fortsatte Lodninger, Temperaturrækker og Trawlinger bestemtes paa Østgaaende, ligesom før paa Vestgaaende, den omtrentlige Grændse mellem Polarstrømmen og det varme Vand i Havets østlige Del. Ligeledes bestemtes Opgangen af Banken noget nordligere end Beeren Eiland, og Undersøgelserne fortsattes videre østover, indtil vi den 23de Juli befandt os paa 74° 57′ N. Br. og 19° 52′ L. Ø. f. Gr., hvor vi havde 21 Favne Vand med en Bundtemperatur af + 0°.2. Her toges en Skrabe, hvorpaa vi, under tiltagende Nordenvindskuling, holdt ned mod Beeren Eiland og derefter østenom Øen til dens Sydside. Søen var her allerede betydelig, saa det var forbundet med Vanskeligheder at gjøre Landgang. Vi saa imidlertid, at vort Flag var borte, og sluttede deraf, at Hollænderne havde været der og fundet Posten, hvilket viste sig at være rigtigt, efter de Efterretninger fra "Willem Barendtsz" som vi modtog fra Vardø ved vor Ankomst til Hammerfest. Den 24de lænsede vi med Storm af NNV., høj Sø, svære Slingringer og tilsidst Regntykke sydover mod Hammerfest. Kl. 10 om Aftenen fik vi et Øjeblik Kjending af Fruholm og Ingø tvers om Styrbord og Kl. 4 Formiddag den 25de kom vi i god Behold til Ankers i Hammerfest. Under Indsejlingen, da det var temmelig mørkt paa Grund af det tætte Regn, opstod Spørgsmaalet om at ankre, før vi kom til Hammerfest. Havde Nordhavs-Expeditionen gjort dette i Maasø, vilde den paa det nævnte Sted have stødt sammen med "Vega"-Expeditionen under Nordenskiöld og Palander, der laa her for at oppebie gunstigere Vejr. Da vi bestemte os til at gaa til Hammerfest med en Gang, passerede de to Expeditioner hverandre paa nogle faa Mils Afstand uden at vide det.

Fredag og Lørdag anvendtes til Fyldning af Vand og Kul, og Mandag den 29de Juli Kl. 6 Eftermiddag forlod vi atter Hammerfest for at udføre vor tredie Tur, idet vi til Afsked saluterede Byen med 4 Skud. Kursen sattes mod Beeren Eiland, som vi, efterat have taget 3 Lodskud og en Trawl undervejs, naaede Onsdag den 31te. Da vi ogsaa kom op under Øen, faldt Barometret 1^{mm} i Timen, ligesom Luften saa saa truende ud, at vi besluttede at se Vejret an i nogen Tid, og efter et Par Timers Forløb havde vi ogsaa fuld Storm. Da vi under disse Omstændigheder ikke kunde arbejde med Lodning og Skrabning, men godt nytte Tiden til Arbejder under Læ, naar Skibet var nogenlunde roligt, holdt vi det gaaende under Øens Østside, hvor Søen var nogenlunde rolig. Thorsdag Aften toges en Del Misvisnings-

of temperatures in close proximity to the ice, we stood on our course, steering first north-east and then north, along the ice, which was soon lost sight of, though the low temperature announced its comparative nearness. Fog, wind, and sea also continued to prevail. On the morning of Friday the 19th of July we had reached a point in lat. 75° 16′ N. long 0° 54′ W. Here a sounding was taken (1985 fathoms), the deepest on this year's cruise, after which we steamed eastward along the 75th parallel of latitude. By a continuous succession of soundings, serial temperatures, and trawlings, the boundary between the Polar current and the warm flow in the eastern section of the Sea was now on our passage east, as before on our passage west, approximately determined. We likewise determined the rise of the bank somewhat farther north than Beeren Eiland, and then continued investigating eastward till on the 23rd of July we found ourselves in lat. 74° 57′, long. 19° 52′ E., with a depth of 21 fathoms and a bottom-temperature of + 0°.2. Here we took a haul of the dredge, and then bore down, in a rising gale from the north, on Beeren Eiland, making for the south coast along its eastern shores. The sea here already running high, considerable difficulty would have been experienced in landing. Meanwhile, we could see that our flag was gone, and of course concluded that the Dutch explorers had found their letter-box, which, on our arrival at Hammerfest, proved to have been correct, a communication received there from the "Willem Barendtz" *viâ* Vardø apprizing us of the fact. On the 24th we stood south for Hammerfest, scudding before the wind in a gale from the north-north-west, with the ship rolling heavily, and a rainy mist coming on. About 10 p.m. we caught a glimpse of Fruholm and Ingø on the starboard beam, and next morning (July 25th), at 4 o'clock, dropped our anchor in Hammerfest harbour. When steaming up the fjord, it was rather dark, from the drizzly rain, and the question arose, whether it would not be best to anchor, for instance at Maasø, before proceeding to Hammerfest. Had this been done, the Norwegian North-Atlantic Expedition would have fallen in with the "Vega" Expedition, under the direction of Nordenskiöld and Palander, then lying at anchor here till the weather should moderate. As it was, the two Expeditions passed within a few miles of each other without knowing it.

Two days (Friday and Saturday) were spent in getting the ship ready for sea (watering, coaling, &c.), and on Monday the 29th of July, at 6 p.m., we again left Hammerfest, on the third excursion of the cruise, firing a salute of 4 guns in honour of the town, as we steamed out of the harbour. The Expedition stood straight for Beeren Eiland, which it reached on Wednesday the 31st of July. On the passage across, 3 soundings had been taken and one cast of the trawl. As we were nearing the land, the barometer began to fall, 1^{mm} an hour; the sky, too, wearing a threatening appearance, we resolved to wait and see how the weather would turn out. And it was well we did, for an hour or two after it blew a gale. Deep-sea operations, such as sounding and dredging, were now, of

og Deviations-Observationer med Skibet, og da Vejret nu havde bedaget sig noget, gjorde Kl. 9½ D'Hrr. Mohn, Sars, Friele, Tornøe, Schmelck og Grieg Landgang ved Engelsk-Elven og foretog en Exkursion langs Østkysten i nordlig Retning. Imidlertid kom Taagen igjen og blev tættere efterhaanden, og Kl. 3 maatte jeg ankre op nær Land for ikke i den stærke Strøm at komme bort fra Landingspladsen eller støde paa Grund. Kl. 4 Fredag Morgen kom Exkursionspartiet ombord igjen, medbringende Fugle, Forsteninger og Planter. Efterat Baaden var ophejst, forsøgte vi at fiske, og det viste sig, at der stod en Mængde Torsk under Øen. Fra Kl. 5 til 7 droges 200 Stykker. Stormen vedvarede fremdeles og først den næste Dags Morgen bedagede den, saa at vi atter kunde sætte Kurs nordover. Samme Dags Eftermiddag naaede vi Station paa 75° 32′ N. Br. og 17° 50′ L. Ø. f. Gr., hvor vi fik 123 Favne og tog en Trawl. Vi oparbejdede nu Partiet til Spidsbergen i to mindre Tversnit, først et mod Vest-Nord-Vest, og derpaa et mod Øst-Nord-Øst og naaede ved Enden af dette Sydkap paa Spidsbergen Mandag den 5te August om Eftermiddagen. Da det blæste en frisk Bris af Nordvest, gik vi i Læ paa Østsiden af Sydkap, hvor vi om Aftenen tog en fuldstændig Misvisningsobservation, og gik om Natten op under den store Isbræ, der skyder som et mægtigt Forbjerg ud i Havet. Om Morgenen den 6te skrabede vi i Storfjorden paa 146 Favne, omsejlede Sydkap og satte derefter Kursen mod Vest. Med Undtagelse af enkelte Isflag, der drev sydover og enkelte mindre Isbjerge i den østlige Horizont var Storfjorden isfri indenfor vor Synskreds. Den 6te og 7de August arbejdede vi paa Snittet vestover og kom i godt Vejr Kl. 9 Eftermiddag den 8de atter under Isen paa 76° 26′ N. Br. og 0° 29′ L. V. f. Gr., hvor vi fik 1686 Favnes Dyb. Trawlen blev sat ud, og der arbejdedes med den hele Natten, men den maa sandsynligvis være bleven fyldt med Rullestene, da Accumulatoren angav en ellers uforklarlig svær Vægt paa Touget, da Indhivningen begyndte. Uagtet al anvendt Forsigtighed sprang Touget, efterat der var hivet ind 3 Timer, Kl. 10 den næste Dags Formiddag. Sprængningen foregik ved en Spleds, der allerede var 3 Tørn inde paa Spillet, og 2160 Favne Toug samt Apparater gik tabt. Vejret var usædvanligt smukt og før vi gik videre, toges en fuldstændig Misvisnings-Observation. Vi styrede derefter nordøstover mellem Isflagene, der nu vare komne rundt om os, og som i det klare Solskin og med sine fantastiske Former var et baade interessant og smukt Syn. Om Eftermiddagen kom vi atter ud af Isen og styrede nu mere nordlig Kurs, saaledes at vi Kl. 3 Formiddag den 10de vare paa 77° 50′ N. Br. og 0° 9′ L. V. f. Gr., hvor vi loddede 1640 Favne. Herfra sattes Kursen østover. Kl. 7 samme Dags Eftermiddag fik vi 1333 Favne, og da nyt Skrabetoug imidlertid var bleven sammenspledset og ny Trawl gjort istand, sattes denne ud. Kl. 9½ næste Formiddag fik vi den hjem med rig Fangst af Dyr og deriblandt Fiske, men Bommen var brækket af paa Midten, og der var en stor Sten paa en Mands Løft i den. Ved det næste Lodskud, der toges om Eftermiddagen, fandt vi

course, out of the question; but as work below could still be done when the motion of the vessel was not too violent, we kept her going, under lee of the land, along the eastern shore, where the sea continued comparatively tranquil. On Thursday evening observations were made to determine the variation and deviation of the compass; and the weather having now begun to moderate, Professors Mohn and Sars, Mr. Friele, Mr. Tornøe, Mr. Schmelck, and Captain Grieg succeeded in landing, at 9.30 p.m., close to the English River, and made an excursion along the east coast in a northerly direction. Meanwhile the fog came on again, getting gradually denser; and at 3 a.m. I had to anchor close in shore, for fear of drifting away from the landing-place, or running aground, in the strong current. On Friday morning, at 4 a.m., the exploring party returned, bringing with them specimens of birds, fossils, and plants. After hoisting up the boat, we passed an hour or two fishing, and found that cod were abundant off that part of the island, our catch from 5 a.m. to 7 a.m. amounting to as many as ten score. It was still blowing hard, and another day had yet to elapse ere the weather became sufficiently moderate to admit of our again pursuing a northward course. On the afternoon of the same day we reached a station in lat. 75° 32′ N., long. 17° 50′ E., where we sounded in 123 fathoms, and took a cast of the trawl. We now explored the tract stretching from that point to Spitzbergen, by means of two smaller transverse sections, one (the first) extending west-north-west, and the other east-north-east, and reached at the end of the latter South Cape, the southern extremity of Spitzbergen, on the afternoon of Monday the 5th of August. As it was blowing fresh from the north-west, we ran in shore east of South Cape, where, during the course of the evening, a complete observation was taken for determining the variation of the compass, and after night-fall we steamed up under the lee of the great glacier that juts out into the sea like a gigantic promontory. On the morning of the 6th we dredged in the Storfjord, at a depth of 146 fathoms, doubled South Cape, and then stood out to sea, steering west. Saving a few isolated floes drifting southward, and several smaller icebergs on the verge of the eastern horizon, the Storfjord was wholly unencumbered with ice, as far as the eye could reach. This and the following day (the 7th) were devoted to exploring the section westward, and on the 8th, at 9 p.m., with the weather fine, we again reached the ice, at a point in lat. 76° 26′ N. long. 0° 29′ W., where we found a depth of 1686 fathoms. The trawl was put over and worked throughout the whole of the night, but probably had got a freight of boulders, the accumulator indicating an otherwise unaccountable strain on the line immediately we began to heave. On the following day, at 10 a.m., the rope parted, in spite of every precaution taken to prevent it, after three hours' continuous hauling. The rupture occurred in a splice, which had already passed 3 turns on the drums, the apparatus consequently carrying away with 2160 fathoms of rope. The weather was magnificent, and before proceeding on our course, we took a complete observation

Dybden at være 1343 Favne. Dette Lodskud har den særegne Interesse og Betydning, at den Svenske Expedition med "Sofia" under Nordenskiöld og von Otter i 1868 fandt en Dybde af 1350 Favne, altsaa kun 7 Favne mere end vi, paa et Punkt der ligger kun 2 Kvartmile længere Vest end vor Station. Resultatet af Lodningen blev derfor imødeseet med en vis Spænding, der maatte være bevirket ved Betragtningen af vore to foregaaende Lodskud, men med den udmerkede Overensstemmelse fulgte Forvisningen om den svenske Expeditions talrige Dyb-Lodskuds Sikkerhed og store Betydning for det Endemaal, som vor Expedition var ude for at søge fremmet. Vi arbejdede nu videre i Retning mod Isfjordens Munding, bestemte Bankens Affald mod Ishavsdybet, og gik derpaa nordover og nordvestover. Sø og Vind var meget hinderlige, saa vi kun gjorde ringe Fart. Om Morgenen Onsdag den 14de August fik vi atter Is i Sigte. Vi var da nær den 80de Breddegrad. Efterat have loddet og trawlet her og længere øst lidt nordenfor 80° Bredde, gik vi om Morgenen den 15dé ind til Norskøerne ved Spidsbergens Nordvest-Kyst.

Sundet mellem Norskøerne er en god Ankerplads, men Isflag drev stadig gjennem det med det stærke Tidvand, og Aftenen før vi kom ind, havde et stort Isflag brukket Kjettingerne og taget 3 af de her liggende 5 Fangstfartøjer med sig ud af Sundet. Der var stor Fiskerigdom, saaledes at 3 Baade med 2 Mand i hver i Løbet af et Døgn kunde fiske og virke 2200 Torsk. De havde blot 20 Minutters Udroning og fiskede paa 16 Favne Vand. Paa Grund af Flueaat (Limaciner) havde Fisken imidlertid her, ligesom ved Beeren Eiland, en meget ubehagelig Smag, der imidlertid skal forsvinde, naar Fisken saltes og klippes.

Medens "Vøringen" laa ved Norskøerne, blev Bunden skrubbet, og der indtoges en Del Ballast, hvortil der lige i Stranden var Anledning til at tage Sten. Skibet

to determine the variation of the compass. Then, standing north-east, we steamed on between the floes, which by this time were floating round the vessel, and in the bright sunshine, with their thousand fantastic shapes, afforded a striking and beautiful sight. In the afternoon we again got clear of the ice, and now taking a more northerly course, had by the 10th, at 3 a.m., reached a point in lat. 77° 50′ N. long. 0° 9′ W., where the depth was found to be 1640 fathoms. We now steered east, and on the same day, at 7 p.m., sounded in 1333 fathoms. A new dredge-rope having meanwhile been spliced, and other trawling-gear prepared, the apparatus was sent down. It came up next morning, at about half-past 9 o'clock, bringing a rich freight of marine animals, among which were a few fishes, but with the boom broken through the middle, and a big stone, as much as a man could lift, enclosed in the bag. In the afternoon we sounded again, and now found the depth to be 1343 fathoms. To this sounding attaches special interest and importance, since the Swedish Expedition despatched with the "Sofia" in 1868, under the direction of Nordenskiöld and von Otter, found a depth of 1350 fathoms — only 7 fathoms more than we measured here — at a point but two miles farther west of our station. The result of the sounding had been awaited with some little excitement after recording the two foregoing depths, and the satisfaction felt at the very close agreement was accompanied by the assurance of the trustworthiness distinguishing the deep-sea soundings taken on the Swedish Expedition, and of their great value as adjuncts in working out the object which the Norwegian Expedition had been despatched to attain. We now explored farther, in the direction of the Ice Sound, determined the slope of the bank towards the depths of the Arctic Ocean, and then stood north and north-west. But the weather was boisterous — wind and sea — and we made but little progress. On the morning of Wednesday the 14th of August we again came in sight of ice, near the 80th parallel of latitude. After sounding and trawling both at this point and farther east, a little to the north of 80°, we proceeded on the morning of the 15th to the Norway Islands, on the north-western coast of Spitzbergen.

In the sound between the Norway Islands there is good anchorage, but floes kept drifting through it with the strong tidal current, and the evening before a large floe, after breaking the cables, had carried 3 of the 5 fishing-vessels that lay at anchor here out of the sound. The place abounded in fish: 3 boats — 2 men to each — could catch and cure in twenty-four hours as many as 2200 cod. The row out took only 20 minutes, and the depth on the fishing-ground did not exceed 16 fathoms. The fish, however, like those on the shores of Beeren Eiland, being infested with parasitic animals *(Limacinæ)*, have a rather disagreeable taste: but this they are said to lose on being salted and dried.

Whilst the "Vøringen" lay at anchor at the Norway Islands, her bottom was scrubbed, and extra ballast taken in, the beach supplying stones in plenty. The ship had

var nemlig blevet noget let paa Vandet, navnlig trængte Agterenden til at komme noget dybere. I Løbet af disse Dage gjordes Exkursioner til Landet indenfor Norskøerne.

Kl. 4 Fredag Eftermiddag den 16de afgik vi atter fra Norskøerne, tog et Lodskud med Temperaturrække udenfor Hakluyt Head, Spidsbergens Nordvestpynt, og sejlede derpaa ned igjennem Smeerenberg-Sundet, østenom Amsterdam-Øen og Dansk-Øen, og ud gjennem Syd-Gat, efter det af Beechey og Franklin i 1818 optagne Kart, hvorefter vi Kl. $12^1/_2$ om Natten ankrede i Magdalena Bay indenfor Halvøen med Begravelsespladsen. Baade i Smeerenberg og i Magdalena Bay er Dalene fyldte med store Isbræer, der gaar lige i Søen, og de fra disse løsbrukne Isstykker flyder om i Sundene og Bugterne. Kl. 9 om Aftenen den 17de loddede og trawlede vi i Magdalena Bay, i hvis inderste Del vi fandt den laveste Temperatur i Søen paa hele Expeditionen, nemlig — 2° C., ved Bunden paa 61 Favnes Dyb, medens Dyrelivet sammesteds var meget rigt, ja selv Fiske kom op i Trawlen. Fra Magdalena Bay styrede vi mod Sydvest udenom Prince Charles Foreland. Den 18de tog vi 4 Lodskud og en Trawl, og den 19de var vi om Morgenen i Isfjordens Munding, hvor der loddedes, toges Temperaturrække og trawledes. Kl. $2^1/_2$ Eftерm. samme Dag gik Expeditionen til Ankers i Advent Bay paa Is-Fjordens Sydside. Landet her gjør en Undtagelse fra det ovenfor beskrevne Spidsbergenske Islandskab, idet Dalene her er fri for Isbræer. Jeg gik strax igang med at optage et Kart over denne af Spidsbergensfarere meget besøgte Bugt, og medens en Del af Medlemmerne var paa en Udflugt op i Landet, arbejdede jeg hermed, assisteret af Professor Mohn, der maalte Grundlinie, enkelte Horizontalvinkler og Solhøjder til Polhøjde- og Tidsbestemmelse, samt Skibsfører Grieg, der udførte Lodninger. Selv maalte jeg de fleste Horizontalvinkler, tog Azimutbestemmelsen, Lodskud og tegnede Kartet. Da de til Kartets Konstruktion nødvendige Observationer var udførte, lettede vi den 22de om Aftenen, tog en Trawl i Mundingen af Bugten, og styrede ud af Isfjorden. Det var Meningen den næste Dag at anløbe Bell-Sund, men det blev tyk Taage og Kursen sattes da hjem mod Norge. Kl. 12 om Natten mellem den 23de og 24de August toges sidste Lodskud og Temperaturrække, og Mandag Middag den 26de August ankredes i Tromsø, hvor vi strax gik i Gang med at fylde Kul og rengjøre Kjedlen. Vi havde da været under Damp uafbrudt i 30 Døgn, idet vi ikke slukkede af under Opholdet i Advent Bay paa Grund af den lave Temperatur, der gjorde Opvarmning af Arbejdsrummet nødvendigt.

Kl. 2 om Morgenen den 29de August afgik vi fra Tromsø og ankom Kl. $10^1/_4$ Form. den 4de September til Bergen.

got too high on the water, more especially her sternpart. During our stay here excursions were made to the mainland.

On Friday the 16th, at 4 o'clock in the afternoon, we again left the Norway Islands, took a sounding, along with a serial temperature, off Hakluyt Head, the northwestern extremity of Spitzbergen, and then steamed on through Smeerenberg Sound, east of Amsterdam Island and Danish Island, and out through South Gat, steering by the chart Beechey and Franklin constructed in 1818, after which we proceeded to Magdalena Bay, where the ship dropped her anchor, at 12.30 a.m., east of the peninsula with the burial-ground. Both at Smeerenberg and Magdalena Bay the valleys are filled up with glaciers, projecting into the sea; and fragments of dislocated ice float about in the sounds and bays. At 9 o'clock on the evening of the 17th we sounded and trawled in Magdalena Bay, where, in its inner part, was found the lowest temperature registered on the Expedition, viz. — 2° C., at a bottom-depth of 61 fathoms. This spot was characterised by a rich variety of animal life, — nay even fishes came up in the trawl. From Magdalena Bay we steered south-west, rounding Prince Charles Foreland. On the 18th we took 4 soundings and a cast of the trawl, and on the morning of the 19th had reached the entrance to Ice Sound, where we sounded, took serial temperatures, and trawled. At half-past two, on the afternoon of the same day, the Expedition anchored in Advent Bay on the south shore of the Ice Sound. The land here forms an exception to the icy region of Spitzbergen described above, no glaciers encumbering the vallies. I immediately prepared to draw up a chart of this bay, so much visited by sealing and fishing vessels, and while part of the Scientific Staff were away on an excursion into the country, continued this work, with assistance from Professor Mohn, who measured the base, some of the horizontal angles and altitudes for determining latitude and time, and from Captain Grieg, who took soundings. Most of the horizontal angles I measured myself; I made, too, azimuth observations, took soundings, and drew the chart. After all the observations required for the construction of the chart had been taken, we weighed anchor, on the evening of the 22nd, took a cast of the trawl at the entrance to the bay, and steered out of Ice Sound. Our intention had been on, the following day to touch at Bell-Sound; but a thick fog coming on, we stood direct for Norway. At midnight on the 23rd of August the last sounding and serial temperature were taken, and on Monday the 26th, about 12 o'clock at noon, the Expedition reached Tromsø, where we at once commenced taking in water and cleaning the boilers. The vessel had been under steam for 30 successive days, the engine-fires having been kept burning during our stay at Advent Bay, in order to heat the work-rooms, which the low temperature prevailing in that locality rendered necessary.

On the 29th of August, at 2 o'clock in the morning, the Expedition left Tromsø, and on the forenoon of the

hvor D'Hrr. Danielssen, Friele, Tornøe og Schiertz debarkerede. Den nu overflødige Del af Besætningen afmønstredes og endel af de Skibet tilhørende Sager bragtes ombord, ligesom Laanegods afleveredes til Bergens Værft. Lørdag Morgen den 7de afgik vi fra Bergen og ankom Kl. 4 Eftermiddag den 9de til Kristiania, hvor D'Hrr. Mohn, Sars og Schmelck gik iland. Næste Dags Middag den 10de September afgik jeg med Skibet til Horten, hvor Desarmeringen strax paabegyndtes. Den 20de var alle Sager bragt iland og Skibet klart til Aflevering med Undtagelse af Donkeykjedlen, der skulde tages ombord i Bergen. Kl. 5¼ Formiddag den 21de gik "Vøringen" fra Horten og ankom til Bergen den 23de.

Der var i 1878 ialt taget 117 Lodskud, 57 Temperaturrækker, 15 Skraber og 24 Trawler, samt, foruden de magnetiske Observationer i Land ved Hammerfest og Vardø, tillige 6 fuldstændige Misvisningsobservationer paa Søen, hvilke paa Grund af Observationsstedernes geografiske Beliggenhed er af megen Interesse.

Det i den oprindelige Plan angivne Farvand mellem Norge, Færøerne, Jan Mayen og Spidsbergen var saaledes befaret og Expeditionens Undersøgelsesrejser lykkelig tilendebragte i den for samme fastsatte Tid.

Den gode Forstaaelse mellem Expeditionens Medlemmer vedvarede uden Forstyrrelse lige til det Sidste. Sluttelig skal det ogsaa med Taknemmelighed bemærkes, at Expeditionen overalt blev mødt med den største Velvilje. Baade Amtmand Finsen paa Færøerne og Landshøvding Finsen paa Island, ligesom ogsaa Bergens, Kristiansunds, Namsos', Bodøs, Tromsøs og Hammerfests Borgere foranstaltede Festligheder i Anledning af Expeditionens Nærværelse og gjorde Alt, for at Opholdet paa de respective Steder skulde blive saa behageligt som muligt.

4th of September, at half-past ten o'clock, we arrived at Bergen, where Dr. Danielssen, Mr. Friele, Mr. Tornøe, and Mr. Schiertz disembarked. Part of the crew, viz. the now superfluous hands, were paid off, divers effects belonging to the ship brought on board, and borrowed gear returned to the Bergen Navy Yard. On the morning of Saturday the 7th of September we left Bergen, and on the 9th, at 4 o'clock in the afternoon, reached Christiania, where Professors Mohn and Sars and Mr. Schmelck went ashore. At noon on the following day I took the vessel to Horten. By the 20th, the ship had been cleared of everything belonging to the Expedition and got ready for her owners. On the 21st, at a quarter past five in the morning, the "Vøringen" left Horten, and arrived at Bergen on the 23rd.

On the third cruise of the Expedition, in 1878, there were taken in all 117 soundings, 57 serial temperatures, 15 hauls of the dredge, and 24 casts of the trawl, together — exclusive of the magnetical observations on shore at Hammerfest and Vardø — with 6 complete observations at sea for determining the variation of the compass, which, from the geographical position of the observing-points possess very considerable interest.

The tract of ocean embraced in the original Scheme, viz. that between Norway, the Færoe Islands, Jan Mayen, and Spitzbergen, had thus been investigated, and the exploring cruises of the Expedition happily terminated within the period appointed.

Nothing arose to cloud the friendly spirit prevailing among the members of the Scientific Staff. Nor must I, in conclusion, omit to record our debt of gratitude for the eager hospitality and ready assistance we everywhere received. Both the chief magistrate of the Færoe Islands, Amtmand Finsen, and the governor of Iceland, Landshøvding Finsen, had festivities arranged in honour of the Expedition, as did also the people of Bergen, Kristiansund, Namsos, Bodø, Tromsø, and Hammerfest, leaving nothing undone that might in any way tend to enhance the pleasure of our stay.

Til Expeditionens Udrustning og Drift har Storthinget bevilget følgende Summer:

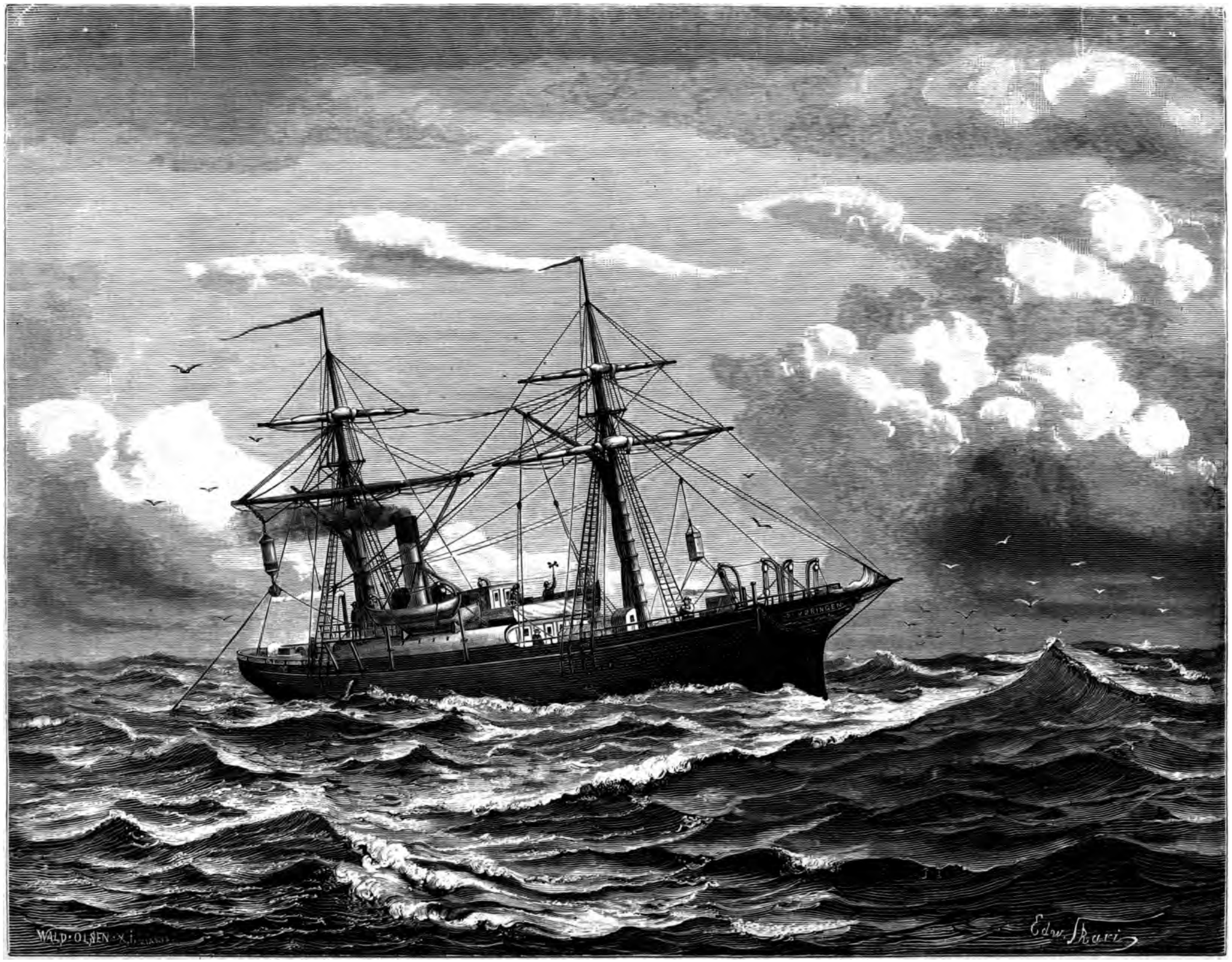
i 1875	20,000 Spd.	=	80,000	Kroner.
i 1876	14,500 —	=	58,000	—
i 1877	28,327 —	=	113,308	—
Tilsammen	62,827 Spd.	=	251,308	Kroner.

Efterat Apparater, Tougverk m. m., der var anskaffet til Expeditionen, blev realiseret ved Bortsælgelse, bliver den Sum, som Expeditionen har kostet ca. 249,000 Kroner. Heri medregnes ikke de Summer, som Storthinget siden 1879 hvert Aar har bevilget til Bearbejdelse af det indsamlede Materiale og til Udgivelse af nærværende Generalberetning.

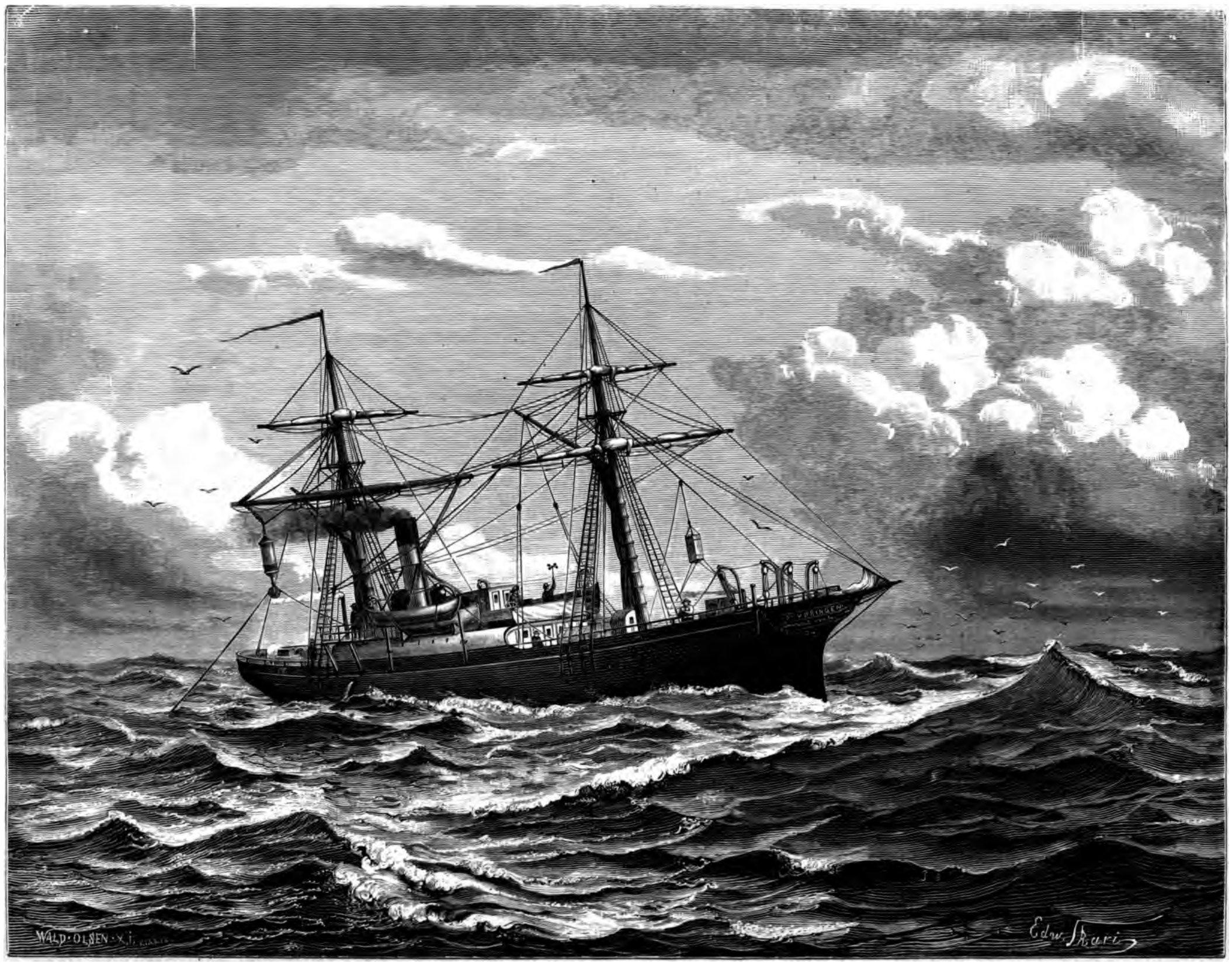
For the equipment and current expenses of the Expedition the Storthing has granted the following sums: —

In 1875	Spd. 20,000	=	Kr.	80,000.
In 1876	— 14,500	=	—	58,000.
In 1877	— 28,327	=	—	113,308.
Total . . .	Spd. 62,827	=	Kr.	251,308.

After deducting the proceeds arising from the sale of apparatus, cordage &c., provided for the Expedition, the nett amount expended will be about Kr. 249,000. This does not include the annual grants made by the Storthing since 1879 for working up the materials collected and publishing the present Report.



VØRINGEN.



VØRINGEN.

DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

APPARATERNE OG DERES BRUG

AF

C. WILLE,

KAPTEJN I MARINEN.

MED ET TITELBILLEDE OG 21 TRÆSNIT.

CHRISTIANIA.

GRØNDAHL & SØNS BOGTRYKKERI.

1882.

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

THE APPARATUS, AND HOW USED.

BY

C. WILLE,
CAPTAIN OF THE ROYAL NAVY.

WITH A FRONTISPIECE AND 21 ILLUSTRATIONS.

CHRISTIANIA.
PRINTED BY GRØNDAHL & SØN.
1882.

Apparaterne og deres Brug.

Indhold.

Som nævnt i min Afhandling om Nordhavs-Expeditionens Oprindelse og Rejser blev det, da Expeditionens Iværksættelse var besluttet, overdraget mig at anskaffe de til Udførelse af de forskjellige Slags Iagttagelser og andre Arbejder nødvendige Apparater. Under min Rejse til England i 1875 anskaffedes saaledes flere Apparater og Instrumenter efter de fra tidligere Expeditioner anerkjendte Modeller. I Løbet af Vinteren 1875—76 udførtes de øvrige Apparater og andre Sager ved norske Verksteder efter de af mig opgivne Tegninger og Betingelser, ligesom jeg organiserede og jevnlig udførte Apparaternes Anvendelse ombord.

Til Grund for den følgende Afhandling, hvis Indhold er angivet ovenfor, er lagt de udførlige Rapporter om Ap-

The Apparatus, and How Used.

Contents.

The Government having resolved to despatch a Scientific Expedition to the Northern Seas, I undertook, as already stated in my account of the origin and cruises of the Norwegian North-Atlantic Expedition, at the instance of the Directors of the Geographical Survey, to procure the various instruments and appliances wherewith it would have to be furnished. Several of these, tested and approved by the experience of former Expeditions, I had constructed in England, from models, when visiting that country in 1875. The remaining apparatus, together with all minor implements requisite for the equipment of the vessel, were made at Norwegian workshops, in the winter of 1875, myself furnishing the designs, and stipulating the conditions on which the work was supplied. Moreover, on the captain devolved the duty of placing and arranging the apparatus, and, as a general rule, of superintending their use on board.

This descriptive exposition, the contents of which have been given above, is in the main an abstract of the special

paraterne og deres Brug, som jeg navnlig i 1876 men ogsaa de følgende Aar indsendte til Direktionen for den geografiske Opmaaling. Fremstillingen er imidlertid bleven for en Del omarbejdet og udvidet, hvad der navnlig gjælder Kapitlet om Navigationen. Efter Professor Mohns Ønske er ogsaa medtaget de af ham, tildels til andre Øjemed, gjorte Studier over Loddernes Udløbshastigheder, over Varigheden af Lodninger og Skrabninger, over Vandloggens Theori og over Kronometrenes Gang, hvis Resultater finde sin naturlige Plads i denne Afhandling. Professor Mohn har ligeledes ydet værdifulde Bidrag til Udarbejdelsen af de denne Afhandling ledsagende Tegninger.

Skibet.

Det til Expeditionen lejede Dampskib, "Vøringen,"[1] var bygget af Træ, og var 35^m (140 n. F.) mellem Perpendiculærerne, 7^m (22$^1/_2$ n. F.) bredt, stak 4^m (13 n. F.) agter og maalte Brutto 344 Tons. Maskinen var paa 55 nominelle Hestekræfter og gav, med et Kulforbrug af 2 Tønder i Timen, Skibet en Fart af 7$^1/_2$ til 8 Knob i roligt Vejr. Besætningen bestod af Chef, 2 Officierer, 2 à 3 Styrmænd, 1 Baadsmand, 1 Tømmermand, 8 helbefarne og 8 halvbefarne Matroser, 2 Maskinister, 6 Fyrbødere, 1 Messekok, 1 Skibskok og 1 Tjener.

"Vøringen" viste sig at være et usædvanlig godt Søskib, og afgav i alle Dele tilstrækkelig Plads, uden at der dog kunde siges at være Rum tilovers. Under Expeditionerne var det, som Fig. 1 viser, foruden med de almindelige Stag- og Gaffelsejl, tillige rigget med Topsejl paa begge Master. Stængerne, der det første Aar (1876) vare ganske korte, forlængedes, saavelsom Topsejlene, 0.^{m}5 (1$^1/_2$ Fod) i 1877 for at skaffe større Sejlareal, men dette var alligevel for lidet til under almindelige Omstændigheder at bruges alene. Heldigvis indtraf der intet saadant Uheld ved Maskinen, at Expeditionen var henvist udelukkende til Sejlenes Brug. De gjorde imidlertid ofte god Nytte saavel ved Manøvrer som til at hjelpe paa Farten. Ved Skibets Udrustning var forøvrigt ikke gjort Regning paa dets Egenskaber under Sejl. Kulboxerne (Fig. 4 *k*) vare udvidede med en Del af Lasterummet under Mellemdækket, saa at de rummede indtil 1400 Tønder, en Forsyning, der var fuldt tilstrækkelig for den længste Tid, som Expeditionen holdt Søen.

Fig. 2 i Forbindelse med Fig. 1 viser de forskjellige Apparaters Plads paa det øverste Dæk. Midten af dette indtages af en Overbygning eller Hytte, hvis Dæk er frem-

[1] Opkaldt efter Vøringfossen i Hardanger.

Reports on the Apparatus and how to work them, drawn up by the author for the Directors of the Geographical Survey, chiefly in 1876, but also in the two following years. Meanwhile, the subject-matter has been carefully revised, and in part expanded, more particularly as regards the section that treats of navigating the ship. At the suggestion of Professor Mohn, Director of the Meteorological Institute, I have incorporated divers investigations, instituted by him partly for other purposes, on the velocity of the sounding-lead, the duration of soundings and dredgings, the theory of the water-log, and the rates of the chronometers, the results of which may be given an appropriate place in this division of the General Report. Furthermore, for not a few of the illustrations I am wholly, or in part, indebted to the pencil of Professor Mohn.

The Ship.

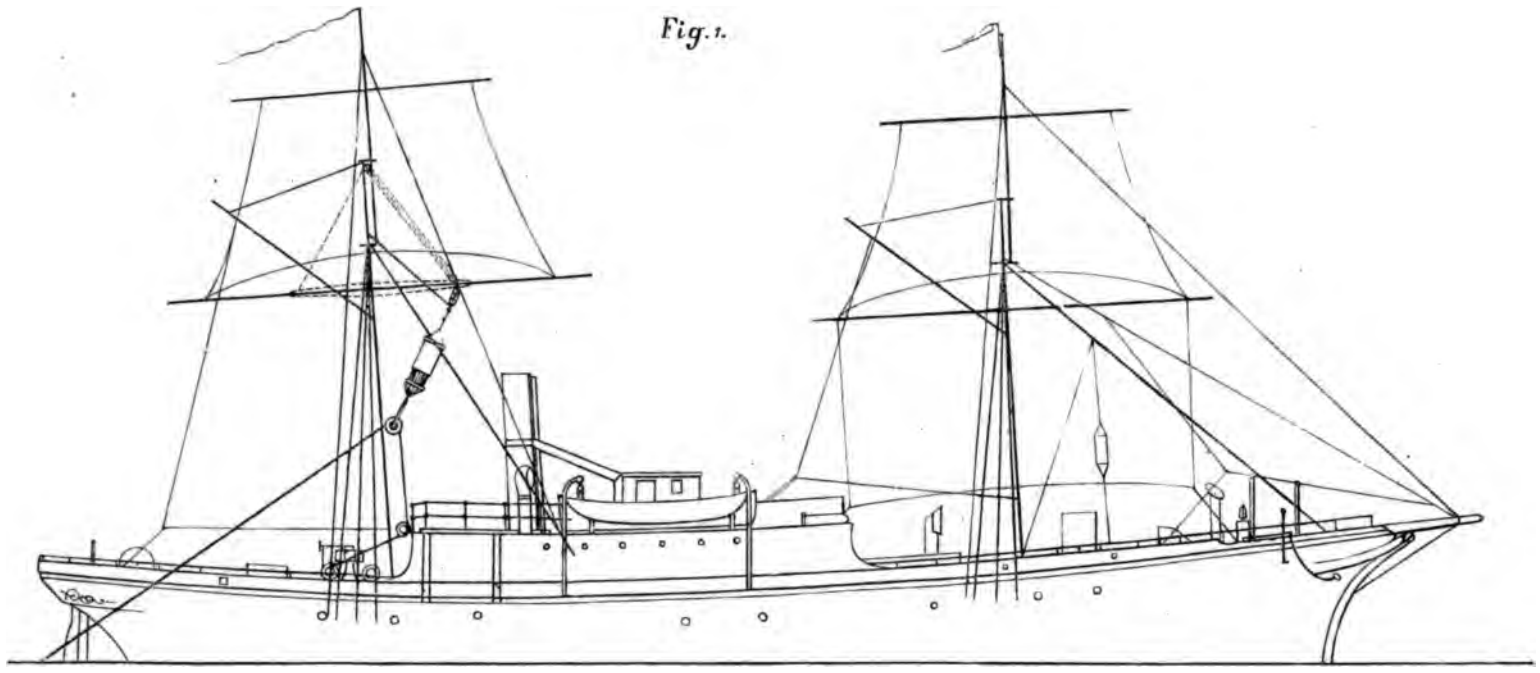
The S. S. "Vøringen,"[1] the vessel selected for the Expedition, was built of wood, had a length of 144 feet between the perpendiculars, 23$^1/_2$ feet beam, and measured 344 tons gross weight. Her engines were of 55 horse power, nominal, and propelled her in calm weather at the rate of from 7$^1/_2$ to 8 knots an hour, with a consumption of 430 pounds of coal. The ship's complement consisted of the captain, 2 chief officers, 2 mates (on the last cruise there was a third mate), the boatswain, the carpenter, 8 able and 8 ordinary seamen, 2 engineers, 6 firemen, a steward, the ship's cook, and one servant.

The "Vøringen" proved an excellent sea-boat, and afforded sufficient accomodation, though it cannot be said there was room to spare. She carried on the three cruises of the Expedition (see Frontispiece), exclusive of the usual fore-and-aft sails, a top-sail on either mast. The top-masts, which were rather short, I had lengthened a foot and a half for the second cruise, in 1877, as also the top-sails, to give greater spread of canvas; but this was still insufficient for working the ship under all plain sail. Fortunately, no such accident occurred to the engine or the screw as would have left the sails our only resource. Yet they often stood us in good stead, no less in handling the ship than to increase her speed. For the rest, the qualities of the "Vøringen" as a sailing-vessel had not been taken into account when equipping her for the Expedition. The dimensions of the coal-bunkers (Fig. 4 *k*) were increased, by encroaching on the hold below the orlop-deck, to admit, if necessary, of stowing about 150 tons, a supply amply sufficient for the longest cruise the Expedition would undertake.

Figs. 1 and 2 show together the general arrangement of the apparatus on the upper deck. The middle portion of the latter was occupied by a roundhouse, of which

[1] Named after the "Vøringfos," a celebrated waterfall in Hardanger.

Fig. 1.



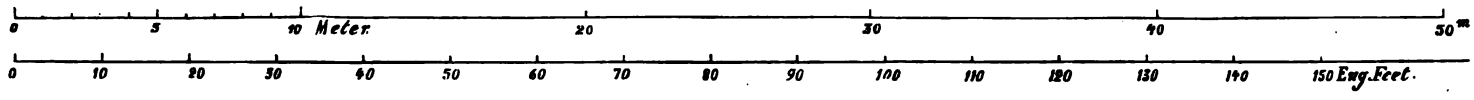


Fig. 2.

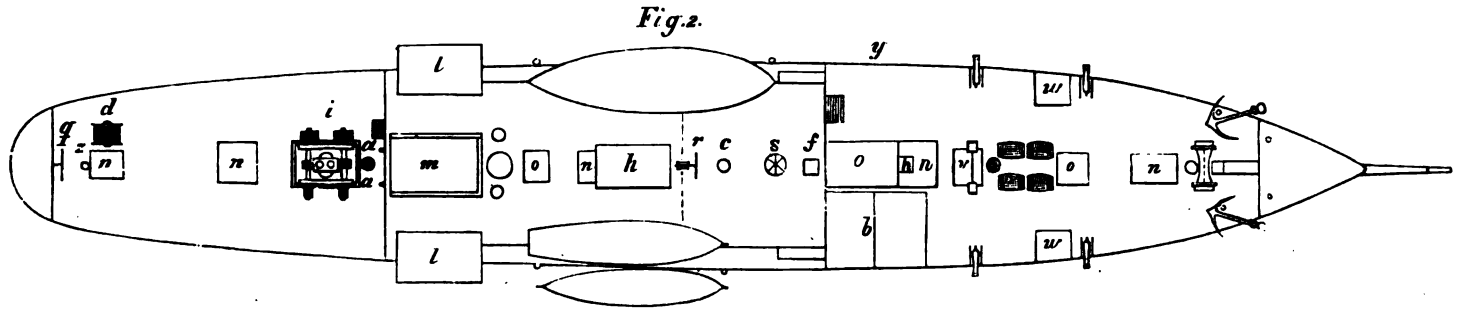


Fig. 3.

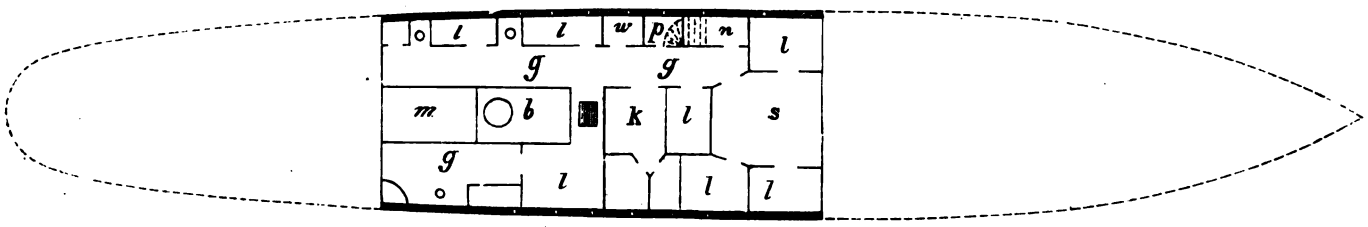
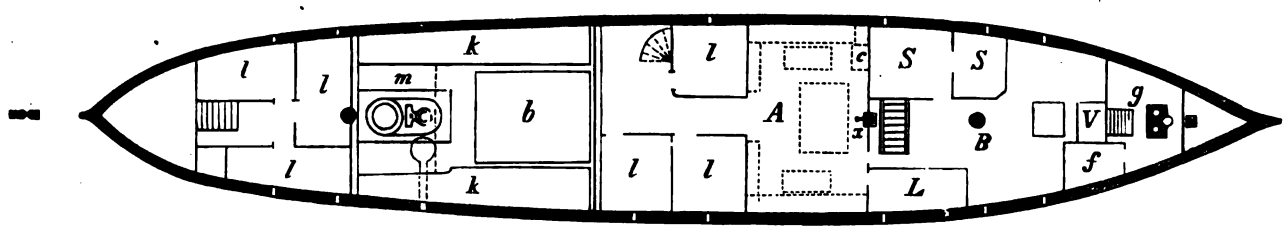


Fig. 4



stillet i Fig. 2 og Indredning under Læ i Fig. 3. Agtenfor Fokkemasten stod en almindelig *Dampwinch* (Fig. 2 *v*), der ved Hjælp af en Kjettingkabellaring kunde benyttes til Ankerhivning. Forrenfor Hytten om Styrbord var opslaaet af Planker en *Binge* (*b*) med 2 Afdelinger, der tilsammen rummede indtil 6000 Favne *Skrabetoug*, og i denne laa Touget klart og luftigt. Paa Fordækket var ligeledes i 1877 og 1878 anbragt 4 *Falconetter*, der med Rapperter og andet Tilbehør velvillig blev udlaant til Expeditionen fra Bergens Værft.

Paa *Hytten* var anbragt en af Skibets *Baade* om Styrbord og udenfor denne hang i Daviderne en Skjækte. Om Bagbord stod Expeditionens store Livbaad, 8.m5 (27 Fod) lang, 2.m3 (7 Fod) bred og 1.m3 (4 Fod) høj i Stevnene. Midskibs i Forkant stod Stativet med Balancebordet til *Fox-Cirkelen* (*f*) og agtenfor Skylightet til Spisesalonen (*s*) stod *Standardkompasset* (*c*) og *Styreapparatet* (*r*). Rathjulet bevægede med Drev den lavere liggende Ratstamme, og i Tandkronen om denne laa Bugten af Kjettingen, der gik gjennem almindelige Skildpadder først ud i Borde, derefter langs Hyttetaget, saa ned paa Agterdækket og agterover langs dette, og endelig gjennem Skildpadder i Borde agterud og paa Rorpinden, der viste agterover. Paa Grund af denne lange Ledning virkede Apparatet langsomt. I 1876 var Kjettingen smekrere og virkede agterud med dobbelt Part paa Rorpinden, i hvis Ende der var tilsvarende Blokke. Den blev let slak og var tilbøjelig til at komme i Uorden. I 1877 anbragtes en sværere Kjetting, der virkede direkte paa Rorpinden, hvorved de nævnte Ulemper hævedes. Det blev aldrig nødvendigt at ty til Vararettet agter (*q*). Lige agtenfor Styreapparatet blev i 1877 opsat et *Bestikhus* (*h*). Paa begge Sider af Hyttedækket og i Agterkant af samme var udbygget *Loddebroer* 3.m1 (10 Fod) lange og 1.m9 (6 Fod) brede (Fig. 2, *l*, Fig. 14 og 21), forsynede med Jernrækverk og støttede med Stræbere mod Skibssiden. I Agterkant af Hytten og paa begge Sider af midtskibs var anbragt "antifriction" *Fodblokke* (Fig. 2 *a*, Fig. 14 og 21), der vare hukede i lange Øjebolte, som løb ned langs Agterkanten af Hytten og gjennem Dæksbjelken.

Paa *Agterdækket* strax agtenfor Stormasten stod *Indhivningsmaskinen* (Fig. 2 *i* og Fig. 5). Den var leveret fra Nylands mekaniske Verksted i Christiania. Den dobbelte vertikalt staaende Højtryksmaskine paa 8 Hestes Kraft drev rundt en under samme langskibs liggende Axel, der forrenfor og agtenfor Krumtapperne var forsynet med to Skruer uden Ende. Disse greb i Tandhjul (Diameter 0.m47 = 1 Fod 6 Tom), der havde svære horizontalt og tverskibs liggende Axler, 2.m37 (7 Fod $6^1/_2$ Tom.) lange, og paa Nokkerne af disse udenfor Lagerne i Ramverket var Tapperne indsmøgede og fæstede med Kiler. Tapperne om Styrbord, der brugtes til Indhivningen af Skrabetouget.

Fig. 2 represents the roof and Fig. 3 the interior fittings. Abaft the foremast was a *Steam-winch* (Fig. 2 *v*), which, when connected with a chain-messenger, would serve for heaving the anchor. In front of the roundhouse, on the starboard side, had been fitted up a spacious and well-ventilated *Locker* (*b*), with two compartments, affording room for stowing away 6000 fathoms of *Dredge-rope,* ready for immediate use. On the forecastle had been mounted, for the cruises in 1877 and 1878, 4 howitzers, kindly lent to the Expedition, along with the carriages &c., from the Royal Dockyard at Bergen.

The roof of the roundhouse, on the starboard side, supported one of the ship's *Boats,* alongside of which, suspended on davits, hung a small skiff. On the port side was placed the lifeboat of the Expedition, 28 feet long, 7 feet beam, and 4 feet deep in the stems. In the forepart, amidships, stood the foot of the balance-board for the Fox-circle (*f*), and abaft the mess-room skylight (*s*) were the *Standard-compass* (*c*) and the *Steering-apparatus* (*r*). By means of cogwheels, the motion of the steering wheel was transmitted to the barrel; and round the latter, over a toothed wheel, lay the bight of the chain, which, on being rove through cheek-blocks in the ship's side, was carried along the roof of the roundhouse down along the after-deck, and then, through cheek-blocks in the ship's side, right aft on to the tiller. With so long a lead, the working of the apparatus proved somewhat slow. On the first cruise, in 1876, the chain had been of smaller size, and rove double on the tiller, through corresponding blocks at the end; hence it easily got slack, and was apt to kink. In 1877, therefore, we substituted a stouter chain, which led singly to the tiller, and were thus able to remedy the defect. On no occasion had we, however, been compelled to have recourse to the spare wheel aft (*q*). Immediately abaft the steering-apparatus, was a small deck-house (*h*), put up in 1877, containing the log-slate, charts, &c. From both sides of the roof of the roundhouse, and from its after extremity, projected *Sounding-bridges*, 10 feet long by 6 feet wide (Fig. 2 *l* and Figs. 14, 21), with an iron railing, and supported by stays against the ship's side. At the after end, and on both sides, of the roundhouse, there were antifriction *Blocks* (Fig. 2 *a*, and Figs. 14 and 21), hooked to long eye-bolts extending down along the after-bulkhead of the roundhouse and thence through the nearest deck-beam.

On the *After-deck*, immediately abaft the mainmast, was placed the the *Donkey-engine* for hoisting the dredging and sounding gear (Figs. 2 *i* and 5), made at the Nyland Works, Christiania. This double-cylinder, high-pressure, vertical engine, of eight horse-power nominal, imparted a rotary motion to a shaft extending fore and aft beneath it, and provided with a pair of endless screws, one before and one behind the cranks. These screws bit into cogwheels (diameter 1 foot $6^1/_2$ inches), fixed on stout horizontal shafts, 7 feet $9^1/_2$ inches long, lying athwartships; and to the ends of these shafts, which projected beyond the bearings on the frame, were fixed the drums, firmly secured

var 0.m41 (1 Fod 4 Tom.) lange og 0.m42 (1 Fod 4 Tom.) i Diameter. Tapperne om Bagbord, der brugtes til Indhivning af Lodlinen, vare 0.m41 lange og 0.m73 (2 Fod 4 Tom.) i Diameter. Alle 4 Tapper havde 5 Furer eller Rifler. Afstanden mellem forreste og agterste Tappecentrer var 1.m14 (3 Fod 7.6 Tom.). Tapperne blev saaledes drevne samtidig rundt med lige Hastighed og samme Vej. Maskinen viste sig særdeles hensigtsmæssig, idet den arbejdede sikkert og kraftigt, kunde baade hale og fire, uden at man behøvede at skifte Linen paa Tapperne, og man undgik

by keys. The drums on the starboard side, for hauling in the dredge-rope, had a length of 1 foot $4^1/_4$ inches, and were 1 foot $4^1/_2$ inches in diameter; those on the port side, for bringing in the sounding-line, had a length of 1 foot $4^1/_4$ inches, with a diameter of 2 feet $4^7/_8$ inches. The 4 drums had each of them 5 flutes, or grooves. Between the foremost and hindmost pair of drums, measured from centre to centre, the distance was 3 feet $9^5/_{16}$ inches. Hence it is obvious, that the drums would revolve simultaneously, with equal velocity and in the same direction. The donkey-

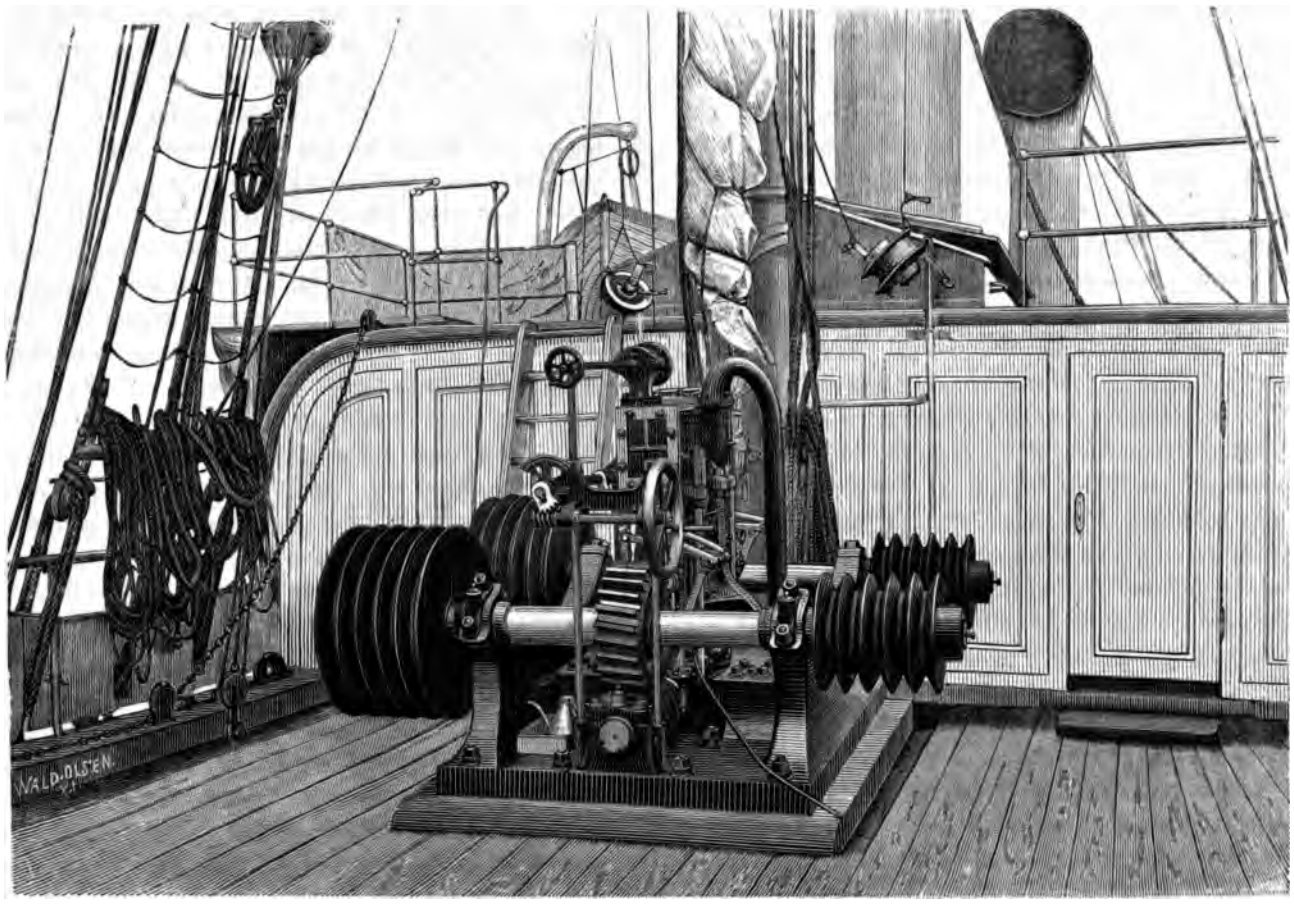


Fig. 5.

Skrændsningen, der følger med Indhivning paa én konkav Tap. De store Tapper om Bagbord tog ind 100 Favne (183 Meter) af Lodlinen i 3 Minuter, og de smaa om Styrbord 100 Favne af Skrabetouget i 6 à 7 Minuter.

I Begyndelsen blev den brugte Damp fra Højtrykscylinderne ledet i en Slange over Dækket og ud over Skibssiden om Styrbord. Da Dampen ved dette Arrangement jevnlig blæstes ind over Dækket og generede, sattes et Kobberrør som Dampskorsten ret op bag Stormasten, hvorved den nævnte Ulempe hævedes.

engine proved a most efficient little machine, working with surprising steadiness and ease; we could haul in or pay out the line without having to shift it on the drums, and there was no surging, which cannot be avoided when the drum is concave. The large drums on the port side delivered 100 fathoms of sounding-line in 3 minutes, and the small ones on the starboard side, 100 fathoms of dredge-rope in 6 or 7 minutes.

On the first cruise, the waste steam escaped through a hose on deck over the starboard side of the vessel; but being with this arrangement, frequently blown back, to the inconvenience of those on deck, the following year a copper steam-pipe was put up abaft the mainmast to get rid of the nuisance.

Ved Siden af agterste Luge var anbragt om Bagbord en Rulle (Fig 2 *d*, Fig. 13 og 14), paa hvilken der kunde oprulles indtil 3000 Favne (5500^{m}) Lodline. I 1876 havde vi en Reserve-Rulle om Styrbord, men denne blev aldrig benyttet.

I Fig. 2 er forresten *n* Nedgangskapper, *o* Skylighter, *m* Maskin-Skylightet, *h* Lufthat, *w* Waterclosets.

Fig. 3 viser Apteringen af *Rummet i Hytten*. *gg* ere Gange paa begge Sider, *s* Spisesalong, *k* Kabys, *l, l. l* ... Sovelugarer, *n* Nedgang til Mellemdækket, *p* Sterrids, *m* Maskin-Skylightet, *b* Kjedlen.

Baade forrenfor og agtenfor Maskinen blev lagt *Mellemdæk*. Apteringen af dette er vist i Fig. 4. *A* er Arbejdssalonen, der indtager Skibets hele Bredde. Den var i 1876 noget mindre, idet Forskuddet stod 0.^{m}6 (2 Fod) længere agter og der var her saavelsom i Lugarerne med Hensyn til Maling og Udstyr anvendt den største Sparsommelighed. Midt under Skylightet, der var anbragt i Skibets Storluge, stod Zoologernes Bord. Meteorologen havde sit Bord om Bagbord og Kemikeren sit om Styrbord. I Figuren betegner *c* om Bagbord Kronometerskabets Plads. Midskibs paa Forskuddet hang Søbarometret. *l, l. l* ... ere Sovelugarer, 3 foran og 3 agtenfor Maskinen. Fra Carljohansværns Verft erholdtes udlaant Chiffonierer, Vaskevandstole, Feltstole samt fornødent Køjetøj til Lugarer og Mandskab, men Rammekøjerne i Lugarerne blev senere paa Turen ombyttede med Slingrekøjer af Træ, som Tømmermanden forarbejdede. Erfaringen fra det første Aar viste, at det var nødvendigt at anvende noget mere Bekostning paa Indredningen, navnlig med Hensyn til Lys og Luft. Kemikerens Arbejde generede ofte de øvrige Herrer, ligesom Skibslugten var en stor Plage, naar Vejret ikke tillod Luftning gjennem Skylightet. Til 1877 Aars Togt blev der derfor gjort flere Forbedringer. Forskuddet i Arbejdssalonen flyttedes 0.^{m}6 (2 Fod) længere forefter. Om Styrbord indrettedes paa Banjerne (*B*) særskilt Laboratorium (*L*) for Kemikerne, med Indgangsdør fra Salonen. Denne blev ordentlig malet med lysgrøn Farve og Gulvet blev tættet og trukket med Voxdug. Langs Forskuddet opsattes en Luftrende (*h*) af 0.1^{qm} (1 Kvadratfods) Tversnit, der ledede frisk Luft ned i Salonen (Fig, 2 *h* og Lufthatten, Fig. 1, der kunde vendes mod Vinden). Den slette Luft førtes ud gjennem et Blikrør, der fra Gangen udenfor Lugarerne gik over Kjedlen (*b*) og op forrenfor Skorstenen. Skuddet paa Forkant af Dampkjedlen (*b*) blev gjort dobbelt og den i Mellemrummet staaende varme Luft givet Afløb paa lignende Maade. Lugarerne agterud havde ogsaa en lignende Ventilationsindretning. Samtlige Lugarer og Banjerne, hvor Folkene laa i Hængekøjer, havde Ventiler i Skibssiden, saaledes som man ser af Fig. 4 og Fig. 1. Lugarerne bleve trukne med hvidt Tapetpapir og Gulvet klædt med Voxdug. De vare meget rummelige og tørre, men varme, naar der var Fyr paa Kjedlen og noget mørke. Varmeledningen, som det første Aar kun bestod af et Jernrør, der var ledet gjennem de forskjellige Rum, blev forsynet med Aftapningskraner og særskilte Dampovne af Kob-

Alongside the aftermost hatchway, on the port side, was placed a large, strong reel (Fig. 2 *d*, and Figs. 13, 14), which held 3000 fathoms of sounding-line. In 1876, we had a spare reel on the starboard side; but it was never used.

Explanation of Fig. 2: — *n* companion hatchways; *o* skylights; *m* skylight over engine-room; *h* ventilator; *w* waterclosets.

Fig. 3 shows the arrangement of the *Deck below the Roundhouse*: — *gg* passages on both sides of the ship; *s* messroom; *k* cooking-range; *l, l, l* ... cabins; *n* companion-ladder to orlop-deck; *p* pantry; *m* skylight over engine-room; *b* boiler.

An *Orlop-deck*, fitted up as shown in Fig. 4, had been laid fore and aft from the engine. The common work-room, *A*, occupies the whole breadth of the ship. The first year of the Expedition it was a trifle smaller, the foremost bulkhead being 2 feet farther aft. Amidships, under the large skylight, for which an opening had been cut in the main-hatch, was placed the zoologists' table; another, that of our meteorologist, stood on the port side; and on the starboard side a third, for the chemical work done on board. In Fig. 4 *c*, on the port side, is shown the case for the chronometers. Amidships, from the foremost bulkhead, was suspended the marine barometer. In the same figure *l, l, l* ... are a row of cabins, 3 on either side of the engine, fore and aft. From the Royal Dockyard of Carljohansværn the Expedition procured cabin furniture, such as chests of drawers, washing-stands, camp-stools, &c., and the necessary bedding both for the cabins and the sailors' hammocks; but in place of the canvas berths we afterwards substituted wooden swinging-berths, made on board by the carpenter. The experience of the first year's cruise, showed some additional outlay for remedying defects in the general arrangements below deck, in particular those connected with light and ventilation, to be highly desirable. Unsavoury smells emitted during the chemical work, would hang about the room, and the foul air from the bilge proved a great nuisance in weather that did not admit of ventilating through the skylight. Divers improvements were accordingly effected before commencing the cruise in 1877. We had the dimensions of the work-room increased, by moving the foremost bulkhead 2 feet farther forward. On the starboard side of the orlop-deck (*B*), a separate laboratory (*L*), opening into the work-room, was fitted up for the chemical work to be done on board. The work-room got a good coating of light-green paint; and after filling up the chinks, the floor was covered with oil-cloth. Along the foremost bulkhead we put up a ventiduct (*h*), 1 foot square, down which an uninterrupted current of fresh air found its way into the work-room (Fig. 2 *h*; Fig. 1 represents the moveable top of the ventilator, which could be turned in any direction to catch the wind). To get rid of the vitiated air, a tin pipe was laid along the roof of the passage extending past the cabins, being carried thence over the boiler (*b*), and up the front of the funnel. Moreover, there being now a double bulkhead afore the boiler (*b*), like provision was made for the escape of

ber i hvert Rum. I Fig. 4 er endvidere *S*, *S* Styrmændenes Rum, *f* Fyrbødernes, *g* Kabysen for Mandskabet, *v* Vandtank, *b* Kjedlen, *m* Maskinen, *k* Kulboxerne.

the heated air between the two partitions. For the cabins aft, too, we adopted this mode of ventilation. Each compartment, as also the orlop-deck, where the crew slung their hammocks, had bull's eye windows (Figs. 4 and 1). The cabins were all of them papered white, and had their floors covered with oil-cloth. They were very commodious, and dry withal, but somewhat dark, and with the steam up, rather close, from their proximity to the boiler. The warming-apparatus, which on the first year's cruise had consisted merely af an iron pipe extending from compart-

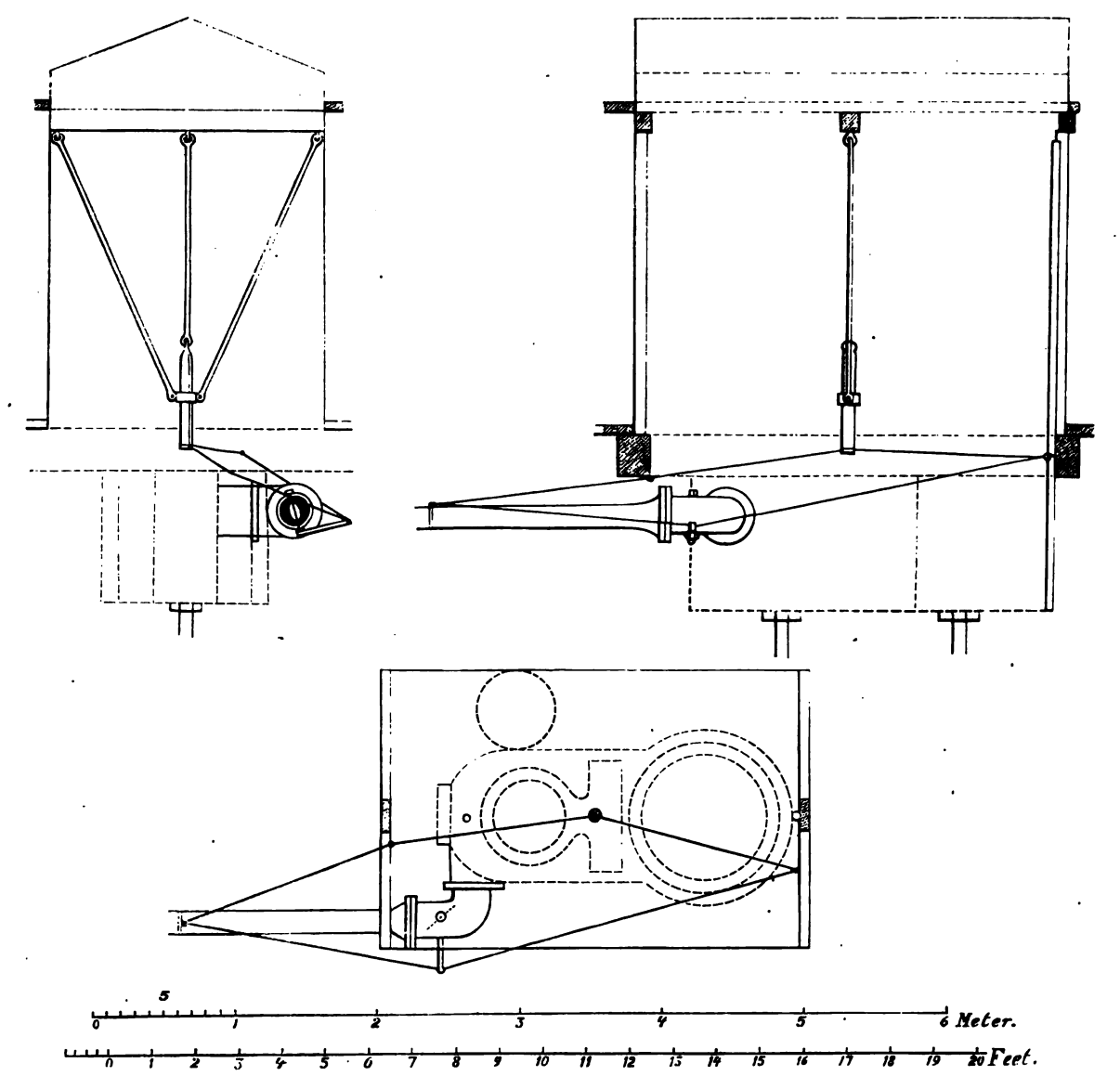


Fig. 6.

Samtidig med Skibet skal jeg omtale *Petersens Pendel-Regulator*, Fig. 6. Som bekjendt er det er stor Ulempe,

ment to compartment throughout the vessel, was now provided with stopcocks for turning on the steam into copper receptacles, or stoves, as they are called, of which each room and compartment had one. Fig. 4 also represents the mates' cabin (*S*, *S*), the firemen's compartment (*f*), the ship's galley (*g*), the water-tank (*v*), the boiler (*b*), the engine (*m*), and the coal-bunkers (*k*).

In my description of the ship and her equipment I must not omit to mention *Petersen's Pendulum-governor* (Fig. 6).

naar Skruefartøjer skal gaa ret mod eller ret undaf Vinden i høj Sø, at Skruen til enkelte Tider kommer ud af Søen, eller i alle Fald saa høit op i Vandet, at den tager en saadan Fart, at der let kan opstaa Havari i Maskinen. Erfaring lærte, at "Vøringen" klarede sig bedst i høi Sø-gang, naar den blev lagt med Stevnen ret mod Søerne, men naar Bølgetoppen havde passeret Skibets Midte, faldt Bougen ned i Bølgedalen og Skruen, som derved løftedes op i Vandets Overflade, slog da saa haardt, at Maskinisten stadig maatte staa med Throttlevalven i Haanden og bremse. Næstcommanderende, Premierlieutenant Petersen, fandt da paa at hænge op et af de store Lodder, der brugtes til Lodningerne, af 112 Pd.s Vægt, under Maskinskylightet, med Forstøtning til Siderne, saaat det blot kunde svinge frem og tilbage i Skibets Diametralplan. I den nedre Ende var fastgjort 2 Snore, der løb gjennem Kouse, en forrenfor Maskinen (over Kjedlen) og en agtenfor samme (i Maskin-skylightet) noget ud i Borde, og begge Snore var med de nedre Ender fastgjorte i Haandtaget til Throttlevalven.

Idet Skibet nu faldt ned med Bougen, svingede Lod-det forefter, trak derved i den agterste Snor og lukkede Throttlevalven. Naar Skibet atter rejste sig, faldt Loddet tilbage og aabnede igjen for Dampen ved Hjelp af den an-den Snor. Grændserne for Loddets eller Ventilens Bevæ-gelser i begge Retninger reguleredes ved et Par paa den agterste Snor fæstede Tværstykker af Træ, der stoppede op imod den agterste Kous i Maskinskylightet.

Gjennem dette enkle Arrangement udførte Loddet den for Maskinisten saa besværlige Tjeneste med Bremsningen, og bedre end han kunde, da Loddet følger Skibets Bevæ-gelser sikkrere end Maskinisten kan. Med fuld Fart hjalp ikke Loddet, da Slideskabet og Cylinderen indeholdt for meget Damp selv efter Throttlevalvens Lukning; men da Maskinisten heller ikke kan gjøre mere end at lukke, er man i dette Tilfælde ved Omstændighedernes Medfør nødt til at regulere til mindre Fart.

It is a well-known drawback with screw-vessels steaming head or stern to wind in a heavy sea, that of the screw being at times either wholly lifted out of the water, or at least brought so near the surface as to cause it to revolve with a rapidity that cannot but expose the engine to serious damage. In rough weather, the "Vøringen" was found to behave best with her head to the sea; but when the crest of a wave had passed the middle of the ship, she would plunge her bows into the trough of the sea, and the screw, being then proportionally raised, tore round with such critical violence at the surface of the water that the engi-neer had to be constantly on the alert, ready at any moment to shut the throttle-valve and cut off the steam. Observing this and the trouble it entailed, Lieutenant Petersen, our second in command, hit upon the ingenious device of sus-pending as a governor under the engine-room skylight one of the heavy leaden sinkers, weight 112 lbs., which he made to swing right fore and aft. At the bottom end of the sinker were fastened two lines, rove through thimbles, one before the engine (over the boiler), and the other abaft it (on the engine-room skylight), a little to the port side, the other two ends being made fast to the hand-lever of the throttle-valve.

Now, when the vessel pitched, the sinker swung forward, and, pulling upon the afterline, closed the throttle-valve; on her again rising, the sinker swung back, opening the steam-passage by its drag on the other line. The motion both of the sinker and of the valve was kept within proper limits by two cross-pieces of wood on the after line, fixed one on each side of the after thimble.

By this simple arrangement, the engineer was relieved from the troublesome duty of throttling, which the sinker performed even more effectually, following the motion of the vessel with far greater nicety than the most watchful eye. At full speed, our pendulum-governor was of no avail, the valve-casing and the cylinder then containing too much steam, even with the throttle-valve closed; however, as the engi-neer can do no more than cut off the steam, in that case there is nothing for it but to reduce the speed.

Lodning.

Lodderne. Naar Dybden ikke antoges at være over 1000 Favne, anvendtes det saakaldte Rør-Lod. Til Lod-ning paa større Dyb brugtes Baillie-Maskinen.

Rør-Loddet (Fig. 7) er af Bly 0.m77 (2 Fod 5½ Tom.) langt, 0.m078 (3 Tom.) tykt og vejer 56 Kgr. (112 Pund). Det har i den nedre Ende et i en Messingmuffe indskruet Jernrør 0.m23 (9 Tom.) langt, 0.m052 (2 Tom.) bredt til Optagning af Prøver af Bunden. Dette Rør har i den øvre Ende nogle Huller for at Vandet kan slippe ud, naar Bundprøven trænger ind nedenfra, og i den nedre Ende en Butterfly-Ventil, der aabner sig opad, og som hindrer Bund-

Deep-sea Sounding.

When the depth was supposed not to exceed 1000 fathoms, we used the tube-lead, as it is called. For sound-ing in greater depths the Baillie machine was employed.

The *Tube-lead* (Fig. 7), 2 feet 6½ inches long by 3 inches thick, is of lead, and weighs 112 lbs. At the lower end it has a brass box, into which is screwed an iron tube, 9 inches long by 2 inches in diameter, for bringing up samp-les of the bottom. This tube has the upper end perforated with a number of holes, to allow of the water passing out above on the sample of the bottom pressing in from beneath, and is furnished at the lower end with a butterfly valve, open-

prøven fra at skylles ud af Røret under Ophalingen. Naar Røret er afskruet, kan et Sidestykke tages ud, hvorved Bundprøven kommer tilsyne med sine naturlige Lag og kan undersøges foreløbig, førend den bringes paa de dertil bestemte Opbevaringskar.

ing inwards, to prevent the washing out of the sample on its journey to the surface. The tube screwed off, the sample within, as it lies *in situ,* may, by removing a slip from the side, be disclosed for preliminary inspection, before being taken to the receptacles in which it is stored

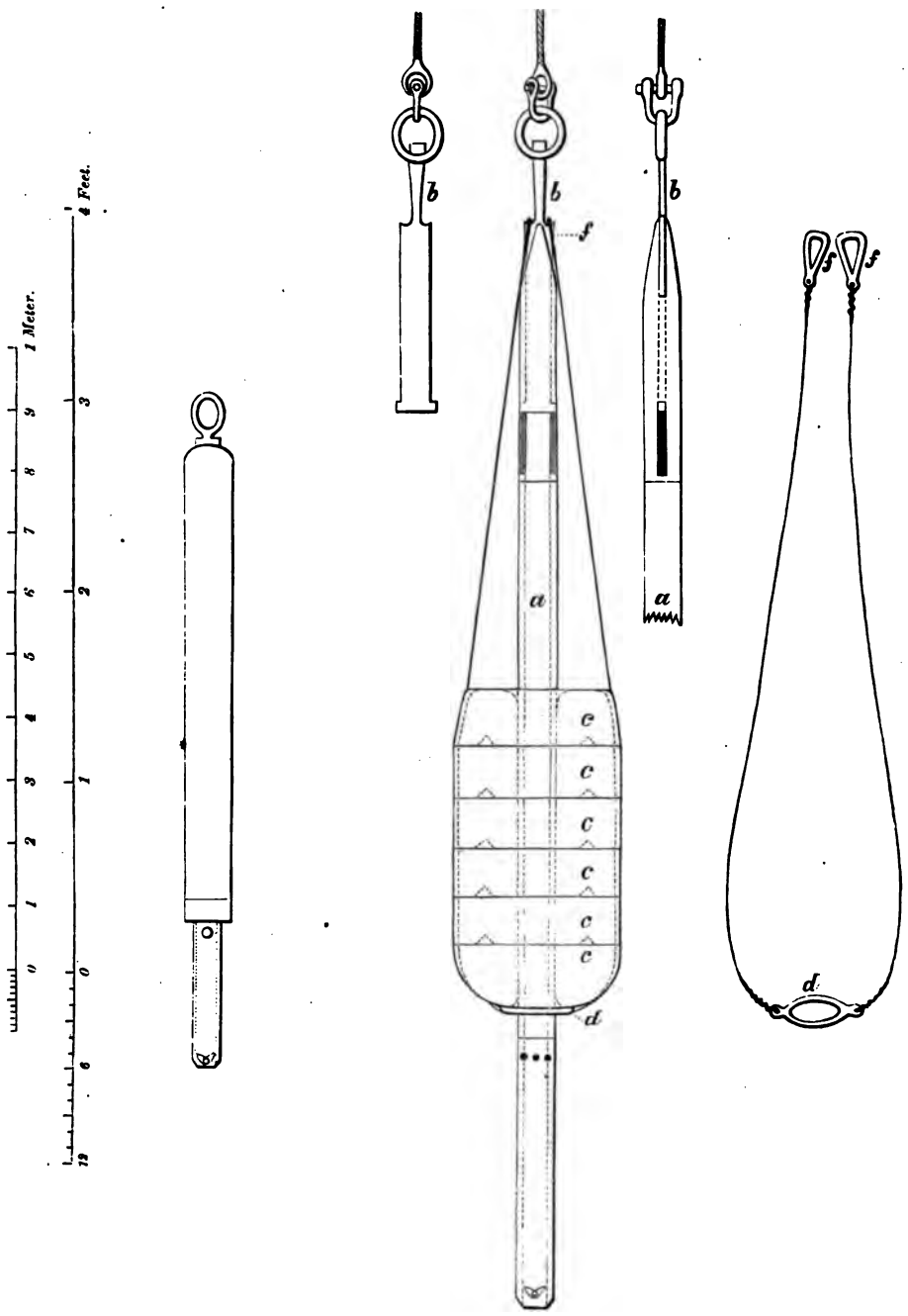


Fig. 7.

Fig. 8.

Baillie-Maskinen (Fig. 8) bestaar af et 1.m75 (5 Fod 7 Tom.) langt, 0.m061 ($2^1/_3$ Tomme) bredt Rør, *a,* hvis øvre Del er af Messing og tilspidset. I Spidsen er en Gjennemskjæring, og længere nede i Flugt med denne en

The *Baillie Sounding-machine* (Fig. 8) consists of a tube *a,* 5 feet 9 inches long by $2^1/_3$ inches in diameter, the upper portion of which is of brass, bevelled away to a long rounded slope. At this end it has a slot,

Aabning paa hver Side. Stykket *b,* der har en Bredde, som er noget mindre end Røret *a*'s indvendige Diameter, er indsat i dette saaledes, at Knasterne ved *b*'s nedre Ende kommer frem i Sideaabningerne, og Stykket *b* kan saaledes bevæges op og ned, fra at Knasten støder an mod Overkant til den støder an mod Underkant af Aabningen. I sidste Tilfælde er *b* ganske skjult inde i Røret med Undtagelse af Ringen. I den nedre Ende af Røret *a* er anbragt den samme Indretning til Optagning af Bundprøve som paa Rør-Loddet.

Til Maskinen hører Jernlodderne *c, c, c,* af hvilke hvert har en Vægt af omtrent 27 Kilogram (55 Pd.). De ere korte Cylindre af støbt Jern med et Hul i Midten af noget større Diameter end Røret *a*'s og med Knaster paa Oversiden samt tilsvarende Fordybninger paa Undersiden og desuden en Fure paa begge Sider, der ligger i Knasternes og Fordybningernes Plan. Naar det ene Lod stables ovenpaa det andet, danner deres Furer en fortløbende Rende. Underlod og Overlod har særskilt Form, som Figuren viser, idet det første er kugleformig afrundet paa Undersiden, for at gjøre mindre Modstand mod Vandet, og det sidste er noget konisk.

Naar Baillie-Maskinen skal rigges, bruges en større cylindrisk Træblok med et Hul i Midten. Over dette lægges Ringen *d,* der er af Støbejern, med isatte Jerntraade, og man stabler nu Lodderne ovenpaa, saa mange som man anser fornødent for med Sikkerhed at kunne angive Øjeblikket, da Loddet slaar i Bund. Derefter sættes Røret *a* gjennem Hullerne i Lodderne og Træblokken, Stykket *b* løftes op, Jerntraadene lægges i Jernloddernes Sidefurer, og Ringene *f* hukes paa de øvre Afsatser paa *b.* Naar man nu løfter op i Lodlinen, der er hexet fast til Ringen i Stykket *b,* hænge Lodderne paa Afsatserne paa Stykket *b,* og Røret *a* hænger med Overkant af Sideaabningerne paa Knasterne ved den nedre Ende af *b,* som i Figuren. Naar Maskinen støder mod Bunden, bliver det løst hængende Rør *a* drevet op og trykker med sin øvre koniske og afrundede Del Ringene *f* ud af Afsatserne paa *b.* Derved er Forbindelsen mellem Jernlodderne og Lodlinen ophævet, Lodderne med Ringen *d,* Jerntraadene og Ringene *f* falde ned og blive liggende paa Havbunden, medens Røret *a* og Stykket *b* bringes op til Overfladen, naar Lodlinen hives ind.

Der blev anvendt indtil 8 Lodder af samlet Vægt 216 Kilogram (432 Pd.). Røret, der hales op, vejer kun 17.5 Kilogram (35 Pd.).

Baillie-Maskinen viste sig at være et udmærket Apparat, idet Lodderne hver eneste Gang, den brugtes, gik af Røret, om end Bunden var noksaa blød. Den eneste Van-

and farther down, in a line with the latter, two other openings, one on either side. The piston-iron *b,* not quite equal in width to the inner diameter of *a,* being so fitted into the tube that the studs at its lower extremity correspond with the aforesaid slots, or openings, can accordingly work up and down within those limits. When the studs are at the bottom of the slots, the piston-iron *b* is just within the brass or upper end of the tube, the ring only by which the instrument is shackled to the sounding-line being then above it. For bringing up samples of the bottom, the lower end of the tube has an arrangement similar to that at the bottom of the tube-lead.

To the machine belong a number of sinkers *c, c, c,* weighing each about 55 pounds, — short cast-iron cylinders, with a hole through the middle slightly exceeding in diameter the tube of the instrument, and toothed and notched so as to fit into one another and make one mass, also having a groove on either side in the same plane with the notches. The top and bottom sinkers differ in shape, the former being slightly conical, and the latter having the lower end spherically rounded, to diminish the resistance and thus increase the velocity in descending.

The Baillie machine was placed for adjustment on a cylinder of wood, having a hole through the middle somewhat greater in diameter than that of the tube *a.* Over the bore of the cylinder is placed a cast-iron ring *d,* with iron wires attached; and upon the ring are piled a number of sinkers, sufficient to determine the exact moment at which the instrument reaches the bottom. The lower part of the tube *a* is next passed through the sinkers into the wooden cylinder beneath; and after drawing out the piston-iron *b,* the wires, forming a sling, are laid in the groove along the sides of the sinkers, and the rings *f* hooked upon the shoulders of the piston. Now, on the instrument being hung to the sounding-line by the ring of the piston-iron, the sinkers will depend, on the iron-wire sling, from the shoulders of *b,* and the tube *a* from the lower studs that retain the piston-iron in position, the brass cylinder being pulled down the entire length of the slots, as shown in the figure. When the tube and the weights touch the bottom, the brass cylinder is pushed upward the length of the slots, and its top rim striking against the rings *f,* the sling is slipped off the shoulders of the piston-iron. The sinkers, being thus deprived of their support, drop, carrying with them the ring *d,* the wires of the sling, and the rings *f,* down the tube *a,* which, on hauling in the line, comes up alone, with the piston-rod and a sample of the bottom.

For some soundings we used as many as 8 sinkers, weighing together 432 pounds. The weight of the tube is only 35 pounds.

The Baillie machine proved an excellent apparatus, the weights being without exception detached from the tube, however soft the bottom. The only difficulty

skelighed var Udfiringen over Rækken og ned i Søen, thi ved Slag mod Skibssiden kunde Jerntraadene løsne og Lodderne tabes. Man firede den derfor saa hurtig som muligt ned i Vandet, hvor dens Svingninger under Fartøjets Bevægelser lettere kunde dæmpes og gjøres uskadelige.

Lodlinerne, der var leverede af Rebslager Timm i Christiania, var af fineste Sort italiensk Hamp, 2.cm6 (1 Tomme) i Omkreds, voxede og glatstrøgne. De holdt ved anstillet Prøve en Vægt af 750 Kilogram (1500 Pd.). De viste sig særdeles gode, og der blev brugt kun en Line hver Sommer. Linen blev mærket for hvert hundrede Favne med omviklede og paamerlede Stykker Flagdug af forskjellig Farve. De første 20 Favne var dobbelt Part med Kous og Hex til Loddet. I 1876 var Lodlinen inddelt i *norske* Favne, og de første 100 Favne havde Lædermærker for hver 10 Favne. I 1877 og 1878 var Lodlinen inddelt i *engelske* Favne og de første 200 Favne opmærkede for hver 10de Favn. Opmærkningen foretoges ombord, idet der med Tommestok blev sat Mærker i Dækket for en Længde af 5 Favne, hvilke ogsaa senere brugtes, naar Linen blev eftermaalt og rettet.

Som anført, havde vi ingen Sprængning af Lodlinen foraarsaget ved at Baillie-Maskinens Lodder ikke gik af Røret. Som Bevis paa Lodlinens Godhed kan anføres, at den under Lodningen en Gang, medens den altsaa var i fuld Fart, gik i Hus i Loddeblokken, idet denne ikke drejede sig hurtigt nok ind i Planet mellem Linens Parter. Uagtet det voldsomme Ryk og det snevre Rum, hvori Linen blev kneben ind i Blokken, over tildels skarpe Kanter, holdt den uden at lide Skade. Den eneste Sprængning af Lodline fandt Sted i 1877 paa Turen nordenfor Tromsø, idet Lodlinen, som under Indhivningen var kommen under Fartøjets Bund, blev grebet af Skruen og sprængt. Ved at fire et Lod i slak Bugt ud fra Stevnen og med Enderne af Linen langs hver af Fartøjets Sider hale det agterud, lykkedes det vagthavende Officer, Capt. Grieg, at fiske Lodlinen, der havde kastet sig om Propelleraxen saa vidt, at den ikke sank; derved reddedes flere Thermometre og de af dem registrerede Bund-Temperaturer.

Accumulatoren bestaar af en Samling Kautschuk-Stroppe (Fig. 9), hver bestaaende af 2 sammenføjede Strenge af 2cm (3/4 Toms) Tykkelse. I hver Bugt er en Træ-Kous med Stjert, og Strengene holdes sammen om Trækousene ved tynde Kautschuk-Ringe. Stroppene ere ordnede mellem 2 stærke Træskiver, 0m.442 (1 Fod 5 Tom.) i Diameter og 0m.045 (1.7 Tom.) tykke, med ligesaamange smaa Huller som der er Stroppe. Stjerten tages gjennem Hullerne og samles om en svær Kous, saaledes at Stroppene blive jevnt stive. Fig. 10 viser Lodde-Accumulatoren. Den be-

lay in lowering the instrument; bumping against the ship's side was apt to disengage the sling, and thus occasion the loss of the sinkers. We therefore got the machine as quickly as possible into the water, where the swinging motion given to it by the rolling of the vessel could produce no injurious result.

The *Sounding-lines,* supplied by Mr. Timm, ropemaker of Christiania, were of the best Italian hemp, 1 inch in circumference, with a breaking strain of 1500 pounds, and well waxed and smoothened. They proved of excellent quality, one amply sufficing for a whole cruise. The lines were graduated into hundreds of fathoms by attached slips of different coloured buntine, wrapped round the surface. Each was rove double the first 20 fathoms, and provided with a thimble and a shackle, by which to make fast the sounding-machine. For the first year's cruise, in 1876, the line was graduated into Norwegian fathoms, and had slips of leather at every 10 fathoms of the first hundred; but for the two remaining cruises, in 1877 and 1878, we substituted English measure, graduating the first two hundred fathoms of the line into tens of fathoms. The line was graduated on board, 5 fathoms having been previously measured out along the deck with a foot-rule. These five-fathom intervals served, too, as a reliable standard when re-measuring and adjusting the line.

As stated above, the weights were detached at every sounding with the Baillie machine; and hence we never had the line carry away from their failing to drop off on the instrument striking the bottom. Meanwhile, the excellence of its quality came on one occasion to be severely tested. When running out with full velocity, the line suddenly caught in the sounding-block, which had not readily adjusted itself to the direction taken by the former on its rapid passage out. But, though brought up in this way with a violent jerk, and jammed besides into the block, partly, too, against sharp edges, the line was strong enough to stand the strain uninjured. The only sounding-line that parted was one used in 1877, on our cruise north of Tromsø. We were hauling in the lead, when it got underneath the ship's bottom, fouled the screw, and was broken. By lowering a weight over the bows in a slack bight, and then, with the ends of the rope extending one along either side of the vessel, hauling it aft, the officer of the watch, Captain Grieg, succeeded in fishing the sounding-line, which had twisted round the screw-shaft just sufficient to keep it from sinking, and thus recovered several thermometers, along with the temperatures they had registered at the bottom.

The *Accumulator* is built up of a number of straps (Fig. 9), each composed of 2 vulcanised india-rubber springs, three-quarters of an inch thick, joined lengthwise. In each of the loops is fixed a wooden thimble, with a lanyard, and the springs are kept together by means of thin india-rubber rings. The straps are kept free from one another and equably taut, by stretching them between a couple of strong wooden disks, 1 foot 5 1/2 inches in diameter and 1 3/4 inch thick, bored with a hole for every strap, the lanyards being rove through the holes and brought

staar af 15 Stroppe. I den nedre Kous hænger Loddeblokken, der er af Jern, forsynet med Hvirvel, Axe, der løber paa Friktionsruller og to Arme med Hængsler til Styring af Lodlinen. Den øverste Kous hukes i et Topreb, der senere skal beskrives, og det hele Apparat hænger,

together round a large thimble. Fig. 10 represents the Sounding-accumulator, composed of 15 straps. To the lower thimble is hung the cast-iron sounding-block, provided with a swivel, an axle revolving on antifriction rollers, and two hinged arms to act as fairleaders for the line. The upper

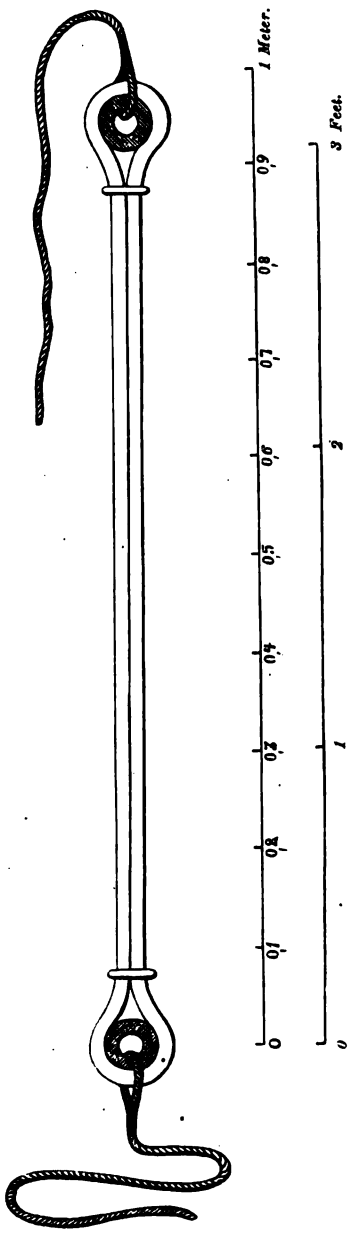


Fig. 9.

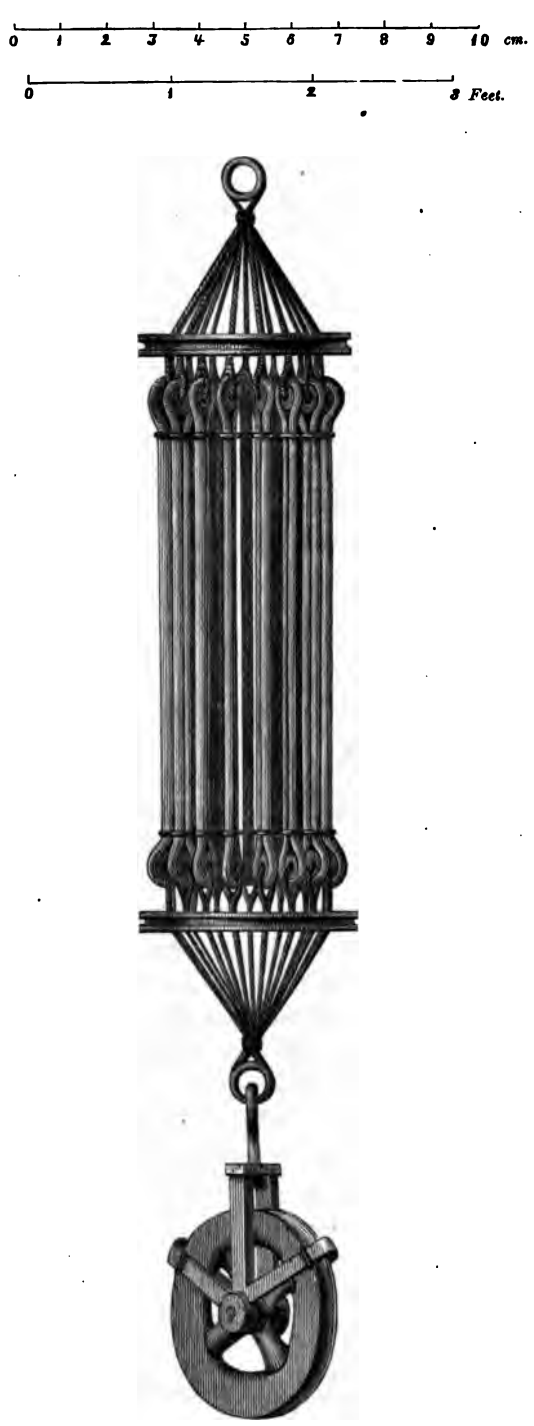


Fig. 10.

naar det er i Virksomhed, under Bagbords Storraa-Nok.

Hensigten med Accumulatoren er at kompensere Skibets Bevægelser op og ned i Søen, saaledes at Lodlinen

thimble is hooked on to a pendant, which will be afterwards described. When in use, the apparatus hangs suspended from the port main-yard-arm.

The most important function of the accumulator is to take off the suddenness of the strain on the line when

ikke bliver udsat for pludselige Ryk. Udvidelsen af Accumulatorens Stroppe tjener ogsaa til at angive Størrelsen af den Kraft, som gaar paa den.

Ved Afvejning i Land fandtes den Vægt, der svarede til hver Fods Udvidelse af en enkelt Strop, og derefter opsattes nedenstaaende Tabel, der dog selvfølgelig kun angiver omtrentlige Værdier. En Accumulator med 30 Stroppe brugtes til Bundskrabningerne.

Længde. Fod.	1 Strop.	15 Stroppe. Vægt i Pund.	30 Stroppe.
3	0	0	0
4	40	600	1200
5	61	915	1830
6	76	1140	2280
7	90	1350	2700
8	101	1515	3030
9	111	1665	3330
10	122	1830	3660
11	132	1980	3960
12	143	2145	4290
13	153	2295	4590
14	162	2430	4860
15	173	2595	5190
16	185	2775	5550
17	198	2970	5940
18	213	3195	6390
19	230	3450	6900

Ved $20^1/_2$ Fods Længde blev Stroppen sprængt.

Da Loddeblokken vejer sine 50 Pd., den største Loddevægt, som ovenfor anført, var 470 Pd., hvortil kommer Vandhenterens Vægt, ser man, at Accumulatoren, paa hvilken der i dette Tilfælde gik en Kraft af noget over 1000 Pd. før Lodderne kom i Vandet, ikke blev meget anstrengt i Forhold til hvad den kunde bære. Under Loddets Synken gaar der ikke stor Kraft paa Accumulatoren, derimod bevirker Lodlinens lange Overflade en saa betydelig Friktion mod Vandet under Ophalingen fra større Dybder, at Accumulatoren kan strækkes ud 0.m2 til 0.m3 (en halv til en hel Fod.)

Kautschukstroppene taaler godt Fugtighed, men angribes af fedtagtige Stoffe og lider vel ogsaa ved stadig Udsættelse for Vind og Vejr. Saasnart Lodningen var forbi, blev vistnok Accumulatoren strax firet ned i Vandet, men det kunde ikke altid undgaaes, naar den var udhalt under Raaen til Brug, at den for en kortere Tid kom i Røgen fra Skorstenen. Den i 1876 brugte Accumulator kunde ikke bruges den følgende Sommer. I 1877 anbragte jeg til Forsøg omkring Stropperne en Serk af Sejldug, der blev fastspigret rundt Kanten af øverste Træskive (se Fig. 1, Skrabe-Accumulatoren, og Titelbilledet samt Fig. 14) og var af samme Længde som Stroppene i Hvile. Ikke usandsynligt paa Grund af denne Beskyttelse holdt Accumulatorerne sig saa godt, at de kunde benyttes i 1878, dog i den sidste Tid forstærkede med nogle nye Reserve-Stroppe.

the vessel is rolling or pitching; but it is also valuable as indicating roughly the amount of the strain, by the greater or less extension of the straps.

By weighting one of the straps, I had found, before the Expedition left Norway on the first cruise, the amount of strain corresponding to its extension, for every successive foot. The results, which of course cannot but represent approximate values, are given in the following Table. An accumulator with 30 straps was used with the dredging-gear.

Length of Strap. Feet.	1 Strap.	15 Straps. Weight in Pounds.	30 Straps.
3	0	0	0
4	40	600	1200
5	61	915	1830
6	76	1140	2280
7	90	1350	2700
8	101	1515	3030
9	111	1665	3330
10	122	1830	3660
11	132	1980	3960
12	143	2145	4290
13	153	2295	4590
14	162	2430	4860
15	173	2595	5190
16	185	2775	5550
17	198	2970	5940
18	213	3195	6390
19	230	3450	6900

At twenty feet and a half the strap broke.

The weight of the sounding-block being 50 pounds, and that of our heaviest set of sinkers, as stated above, 470, to which must be added the weight of the water-bottle, the accumulator, which accordingly had to bear a strain of but little more than 1000 pounds before the sinkers reached the water, was not exposed to any severe test, considering the great strength of the straps. During the downward passage of the lead, there is very little strain on the accumulator; but when hauling in, the friction of one or two miles of cord in the water is so considerable, that the accumulator will be frequently stretched from half a foot to a foot.

The india-rubber springs stand wet and moisture well; they are, however, injuriously affected by grease and all kinds of fatty substances, and probably, too, suffer from continued exposure to wind and weather. Immediately after sounding, the accumulator was lowered into the shrouds; but when triced under the yard-arm for use, it was not always possible to keep it out of the smoke from the funnel. The accumulators provided for the first year's cruise, in 1876, had to be rejected on the next. To remedy this drawback, I tried, in 1877, the experiment of nailing round the rim of the upper disc a protective covering of canvass, of the same length as the unstretched straps (see Fig. 1, Dredge-accumulator, Frontispiece, and Fig. 14). Owing, probably, to this simple expedient, the accumulators kept in so good a condition as to admit of our using them

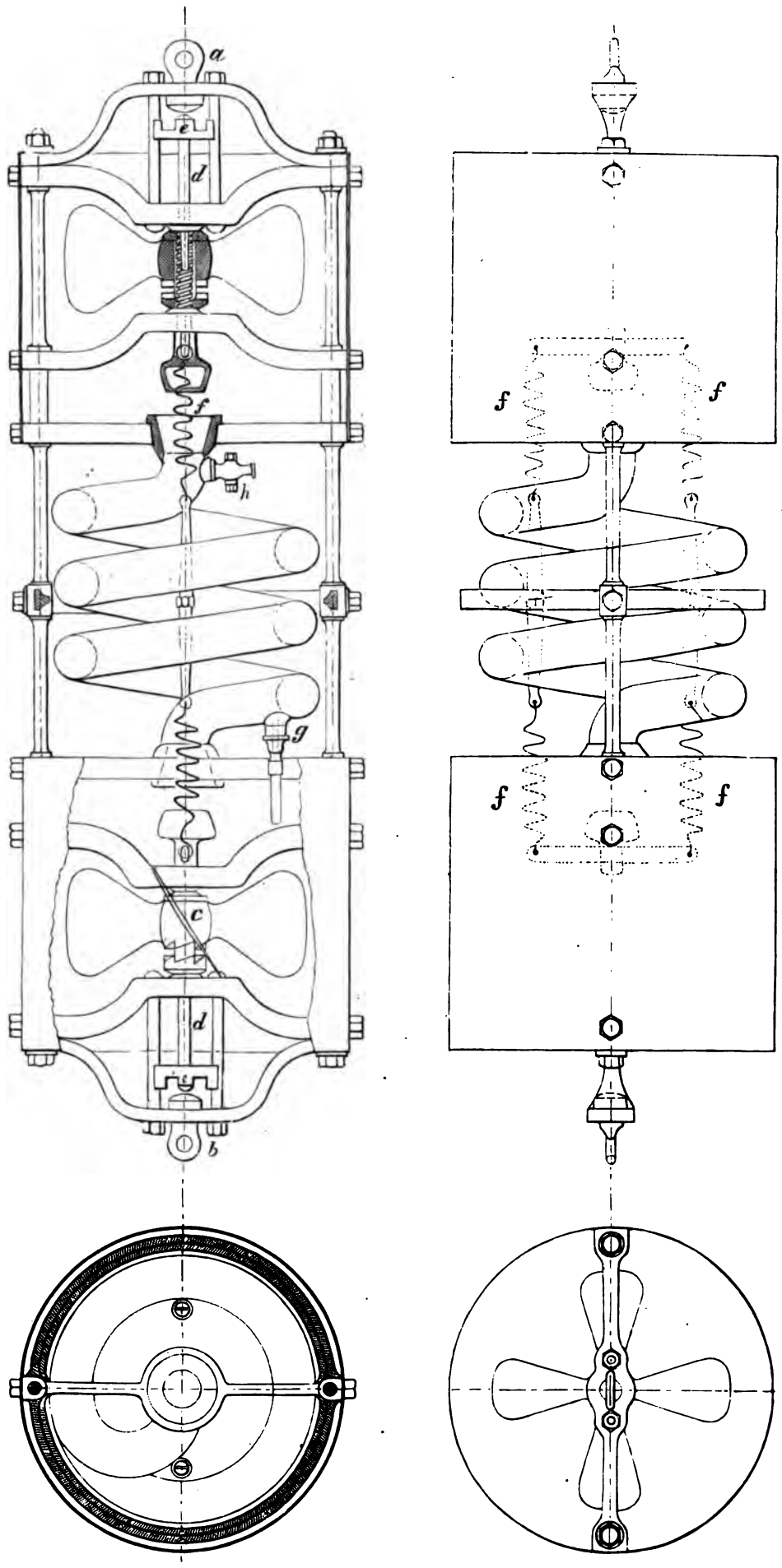


Fig. 11.

Thermometre. — De Dybvandsthermometre, der benyttedes paa vor Expedition, vare Casella-Millers, Buchanans (Kviksølvpiezometer) og Negretti og Zambras, den ældre og den nyere Model. Desuden gjordes Forsøg med Vand-Piezometre til Kontrolbestemmelser for de maalte Dybder. Alle disse Instrumenter ville blive beskrevne af Professor Mohn i hans Afhandling om Dybvands-Temperaturerne.

Vandhenter. — Paa vor Expedition anvendtes hovedsagelig den af mig dertil konstruerede, i Fig. 11 i $^1/_8$ af den sande Størrelse fremstillede Vandhenter. Instrumentet, der blev prøvet i Christiania før det blev antaget, blev brugt under den hele Expedition, saavel paa de større som paa mindre Dyb. Da Kemikeren havde stillet Fordring paa 5 Liter Vand, blev Apparatet meget stort, hvilket vistnok ikke generede Indhalingen i mærkelig Grad, men det gjorde det noget tungvindt at haandtere paa Dæk.

Vandhenteren er i Figuren fremstillet færdig til Udfiring. Tampen af Lodlinen hexedes i øverste (*a*) og Loddet i nederste Øjebolt (*b*). Under Udfiringen strømmer Vandet frit gjennem det, for Pladsens Skyld, spiralformig bøjede Rør, der var af Kobber og indvendig fortinnet. Samtidig løftes Propellerne op, saa at Taggerne i Underkant af Propelbosset *c* kommer klar af Taggerne i Muffen om Ventilstangen, og om de ikke skulde komme ganske klare, sker Propellens Omdrejning med Skraaplanerne, saaat Muffen og den gjennem samme gaaende Ventilstang *d* bliver staaende stille. Naar derimod Instrumentet under Indhivning bevæges opad, trykker Vandtrykket Propellerne ned, de drives rundt den anden Vej og tager Muffen med sig. Ventilstængerne, der styres af Tverstykkerne *e* og Ventilerne, der ere overtrukne med Kautschuk, skrues da mod Ventilsæderne i Enden af Røret, og naar de er næsten lukkede, glipper den sidste Skruegjænge i Ventilstangen ud af Skruegjængerne i Muffen og Spiralfjædrene (*f*) klappe da Ventilen i, og holder dem lukkede under Resten af Indhivningen, medens Propellerne og Mufferne gaa løse rundt den glatte Del af Ventilstangen og saaledes frembyde meget liden Modstand. Instrumentet lukkede sig efterat være indhalt 6 à 7 Favne. Skjærmene om Propellerne beskytter disse, saa at Instrumentet uden Skade kan ligge paa Bunden.

Da man ønskede at konstatere, om der var Overskud af Luft i de dybere Vandlag, blev der over Svikhullet (*g*) paa Røret paaskruet et gjennemboret Laag, og dette blev forenet med et i den ene Ende lukket Glasrør ved Hjælp af et Stykke Kautschukslange. Naar Vandet under Nedfiringen strømmede ind i Vandrøret, løb det ogsaa ned i

the year after (1878), strengthened, however, on the latter part of the cruise with a few spare straps.

Thermometers. — Of deep-sea thermometers, the Expedition was provided with the Miller-Casella, Buchanan's (mercury-piezometer), and Negretti & Zambra's (on the original and the improved construction.) Experiments were also made with water-piezometers, to control determinations of depth. These instruments will all be described by Professor Mohn, in his Memoir on the deep-sea temperatures.

The Water-Bottle. — For collecting water both from the bottom and intermediate depths, we made chief use, on each of the three cruises, of an instrument devised by myself, and tested in Christiania previous to the departure of the Expedition. Fig. 11 represents this water-bottle, one-eighth of the actual size. The apparatus having, as stipulated by Mr. Svendsen, chemist to the Expedition, to bring up 5 litres of waters, it was of course rather bulky; but this, though it made the instrument somewhat cumbersome to handle on deck, did not materially impede the heaving in.

In the figure, the water-bottle is shown ready to let go. The end of the sounding-line is shackled to the upper eyebolt (*a*), and the lead to the lower (*b*). On the downward journey, the water passes freely through the tube, which is of copper, tinned on the inside, and which, to save space, had been given a spiral form. Now, the pressure of the water will lift up the propellers, enabling the cogs in the under surface of the boss (*c*) to get clear of the cogs in the bush, through which passes the rod of the valve (*d*); and if not quite clear, the propeller will revolve *with* the inclined planes, the bush and the valve-rod remaining stationary as before. On the other hand, when the instrument, on being hauled in, is given an upward motion, the pressure of the water will force down the propellers, and they will then revolve in the opposite direction, carrying along with them the bushes. The valve-rods, which cannot revolve, being kept in position by the cross-pieces (*e*), will then, together with the valves, covered with india-rubber, be screwed against the valve-seats. When the valves are well-nigh closed, the last twist of the screw on the rod of the valve will slip out of the corresponding twist of the screw on the bush, and the spiral springs (*f*) instantly press down the valves and prevent the enclosed sample of water from escaping, the propellers and the bushes being left to revolve independently round the flush portion of the rods, thus affording very little resistance on the passage to the surface. The instrument closes on being hauled in 6 or 7 fathoms. The shields round the propellers serve to protect them from damage when the instrument is lying on the bottom.

With a view to ascertain whether the proportion of air were really greater in the deeper strata of the ocean, a perforated cover was screwed over the spigot-hole (*g*), and connected, by means of a short piece of india-rubber hose, with a glass tube, sealed at one end. Now, when the water on the downward passage of the instrument entered

Glasrøret, af hvilket saaledes den atmosfæriske Luft blev udjaget. Naar Instrumentet kom ombord, endevendtes det, saaledes at Kranen *h* kom ned og Glasrøret op. Man bevægede nu Vandhenteren lidt frem og tilbage med den øvre Ende, og hvis der havde været Overskud af Luft, maatte denne have arbejdet sig op, og vist sig i Toppen af Glasrøret. Dette viste sig imidlertid i ethvert Tilfælde fuldt af Vand lige til Tops, og blev derfor i den senere Tid ikke paasat.

Til mindre Dybder, og naar man ikke behøvede at standse Udfiringen, benyttedes en mindre Vandhenter konstrueret af Professor *Ekman* i Stockholm. Dette Apparat er fremstillet i Fig. 12. Det bestaar af en i begge Ender aaben Cylinder *c*, der har en Brem rundt om den øvre Kant. Denne Cylinder løber op og ned langs tre[1] Styrestænger *d*, hvis øvre Ender er forbundne med et Tværstykke, og de nedre Ender er fæstede til en Bund, der har en med Fedt eller Guttapercha fyldt Udskjølpning rundt om, i hvilken Cylinderens nedre Kant passer. I denne Bund er ogsaa en Udtapningskran. Fra Midten af Bunden staar op en Stang, der bærer en Skive med Kanter af ombøjet Kautschuk, og som lukker Cylinderen foroven, naar den er sluppet ned. I denne Skive er et Svikhul, lukket med en Prop. Cylinderen hukes med en Sliphage *a* i det øvre Tværstykke mellem Stængerne, og denne Hage holder da Cylinderen oppe, medens Apparatet løftes over og langs Skibssiden, men naar man lader det falde i Vandet, løftes Cylinderen lidt af Vandtrykket under Bremmen og Sliphagen falder ned. Vandtrykket holder da Cylinderen fremdeles oppe, saalænge Instrumentet synker raskt, men idet man standser Udfiringen eller ved Bunden, falder den ned og indeslutter Vandet. Hagen *b* griber fat under Bundstykket og hindrer Cylinderen fra at løfte sig mere, naar den engang er faldt ned.

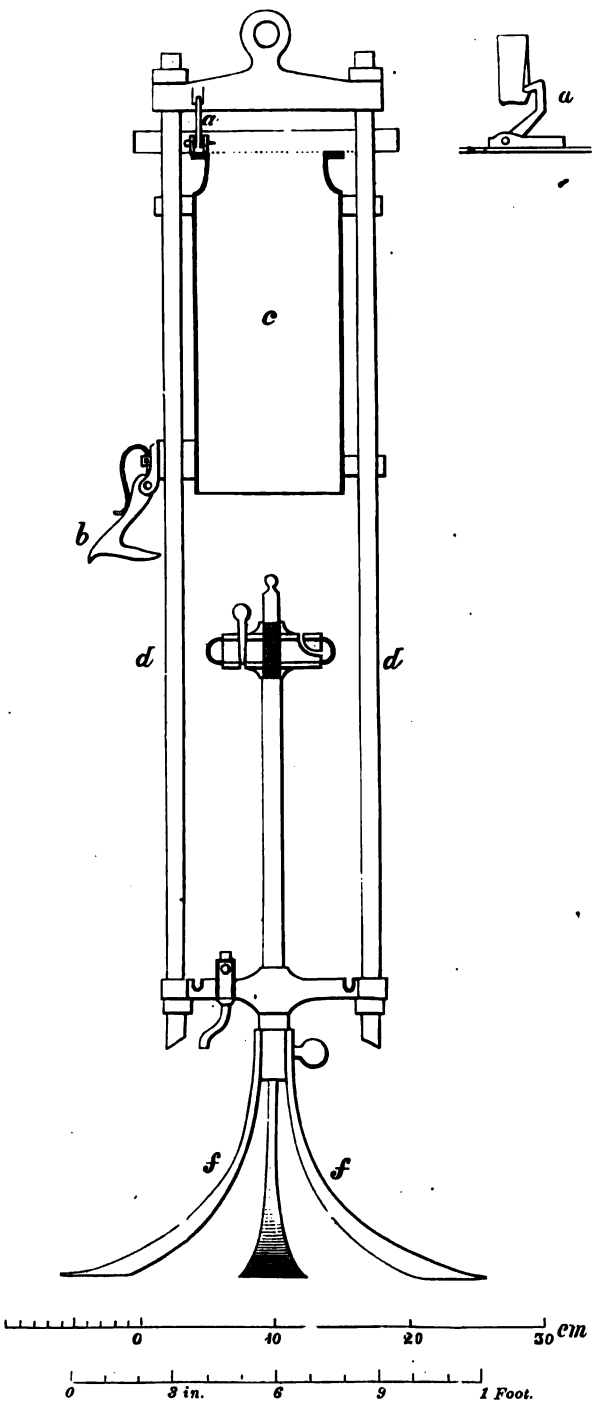


Fig. 12.

[1] I Figuren er for Tydeligheds Skyld kun tegnet to.

the spiral copper tube, it also flowed into the glass tube, expelling the atmospheric air. So soon as the instrument came on board, it was inverted, the stopcock (*h*) pointing down and the glass tube up. The upper end of the apparatus being then moved gently backwards and forwards, the surplus of air, had any such existed, must obviously have forced its way upwards, and have appeared, in the form of bubbles, at the top of the glass tube, which, however, was invariably found to be full of water; and hence we ceased to attach it when the fact would no longer admit of doubt.

For moderate depths, and when not obliged to check the line in veering out, we used a smaller water-bottle, constructed by Professor *Ekman* of Stockholm. This instrument is represented in Fig. 12. It consists of a brass cylinder (*c*), open at both ends, and with a flange round the upper rim. The cylinder slides up and down 3[1] metal guides, the upper ends of which are connected by a beam, the lower end being fixed to a circular bottom-piece, having a grooved rim filled with grease or guttapercha, into which the cylinder fits. The bottom-piece is also provided with a stopcock; and, projecting upwards from the centre, extends a stout rod, bearing a metal disk, the rim of india-rubber, which serves to close the top end of the cylinder, on the latter having slid down the guides. In the disk is a spigot-hole, stopped with a plug. The cylinder is attached to the beam, between the guides, by means of a slipping-hook (*a*), which keeps it suspended when lifting the apparatus and lowering it over the ship's side; but on its reaching the water, the pressure against the under surface of the flange slightly raises the cylinder and slips it off the hook. Meanwhile, the pressure of the water will retain the cylinder at the top of the instrument, the descent being sufficiently rapid; but on checking the line, or the instant the machine touches the bottom, it will slide down and shut in a sample of

[1] To avoid apparent complexity, only two of the guides are shown in the figure.

Loddet i Bund, udførtes samtidig med Fartøjet og med Apparaterne paa Dæk.

Manøvre med Fartøjet. Ved Ankomsten til Loddestationen lagdes Fartøjet med Stevnen ret imod Vinden og stoppedes. I denne Stilling søgte man nu at holde

and for sinking the lead to the bottom, we carried out together, handling the vessel and the deep-sea apparatus simultaneously.

Handling the Ship. — On arriving at a sounding-station, the vessel was put head to wind and her way deadened. In this position we tried to keep the ship as

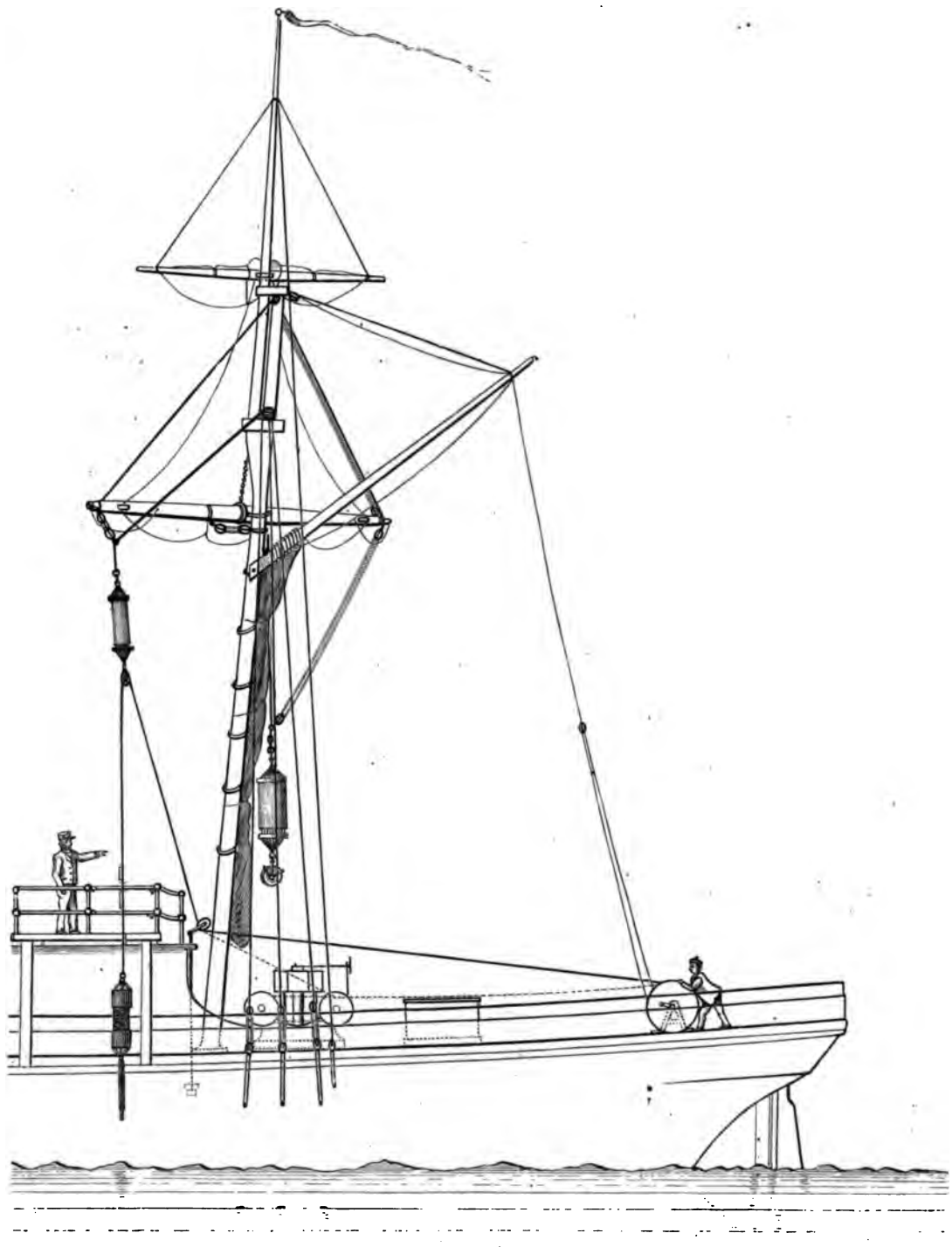


Fig. 14.

det paa samme Plads hele den Tid, Loddet behøvede for at komme til Bunds. Ved afvexlende at lade Maskinen gaa langsomt forover, naar Fartøjet begyndte at sakke, og stoppe, naar Lodlinen begyndte at vise agterover, opnaaedes i Regelen Hensigten, idet Skruevandet gav tilstrækkeligt Tryk,

near as possible stationary during the passage of the lead to the bottom. By alternately starting the engine as soon as the vessel had got sternway and stopping when the line began to point aft, we generally managed to gain our object, the water thrown back by the screw acting on the rudder

er af Vigtighed for Nøjagtigheden af den følgende Beregning af Dybden. Det Stykke af Lodlinen, der er mellem Rullen og Fodblokken, maa altid have en passende Stramning, saaat Linen ikke under Bevægelsen slaar Bugter, der kunde bringe den til at kaste sig om en eller anden fremstaaende Gjenstand og derved foraarsage Havarier eller en pludselig Standsning af Lodlinens Bevægelse. Denne Bremsning fordrer derfor baade Opmerksomhed, Kraft og Øvelse.

I 1877 forsøgte jeg en mekanisk Bremse paa Rullen, men den viste sig upraktisk og anvendtes kun nogle Gange. Naar Skibet løfter sig paa Søen, rives Linen af Rullen med stor Kraft, og naar det atter sænker sig, formindskes Loddets Drag, ja ophæves undertiden næsten for et Øjeblik. Disse uafladelige Forandringer føles strax, naar man bremser med Haand, og med nogen Øvelse vænner man sig til at bremse netop det nødvendige, men med den mekaniske Bremse viste det sig ugjørligt at følge Forandringerne, der ikke føltes gjennem Apparatet.

Ved Dybder, der ikke oversteg 900 til 1000 Favne, mærkedes bedst, at Loddet slog i Bund, derved, at man lod Linen løbe ganske løst gjennem Haanden, og man følte da en pludselig Aftagen i Udløbshastigheden. Man kunde ogsaa tydelig se det derved, at Linen mellem Fodblokken og Rullen lagde sig pludselig flad ned paa Dækket. Saasnart over 700 Favne var ude, var den Bremsning, der udfordredes for at holde Linen stram, kun ringe. I nogle faa Tilfælder, i hvilke der blev loddet paa 1100 til 1200 Favne med Rørlod alene, viste det sig, at det ikke var muligt at iagttage det Øjeblik, da Loddet kom i Bund. Linen vedblev at løbe ud paa Grund af sin egen Vægt med en Hastighed, der ikke var synligt forskjellig fra den Hastighed, hvormed den løb med Loddet som Tillægsvægt. Under saadanne Omstændigheder loddedes om igjen med Baillie-Maskine, dersom det ansaaes fornødent at faa et nøjagtigt Lodskud. Med Rørlod og Willes Vandhenter sammen kunde der faaes gode Lodskud paa over 1100 Favne, som et Forsøg paa Station 247 viste. Her gav nemlig Baillie-Maskinen 1120 Favne, medens Rørlod med Vandhenter gav 1124 Favne.

Bestemmelse af Dybden. Da Lodlinen for de større Dyb kun var mærket for hver 100 Favne, maatte det nøjagtige Favnetal søges ved særegne Observationer og Beregninger. Den fra først af brugte Fremgangsmaade var følgende. I det Øjeblik, Loddet gik i Vandet, og naar et Hundrede-Favne-Mærke gik i Vandet, raabtes „Nu" og Klokkeslettet noteredes i Loddejournalen paa nærmeste Sekund. Forat give Noteringerne større Sikkerhed, varskoedes af Folkene ved Rullen altid i Forvejen „Mærke", naar et af Mærkerne gik af Rullen. I det Øjeblik Loddet var i Bund, raabtes „Bund" og det tilsvarende Klokkeslet noteredes. Af Rækken af de under hverandre noterede Klokkeslet toges første Differents. Disse Tal stige med Dybden, idet Udløbshastigheden aftager med Længden af den gjennem Vandet løbende Lodline. Dernæst beregnedes

presented in Fig. 14. The two men with leather gloves endeavoured, by pressing upon the reel, to keep the motion as uniform as possible, this being an essential condition for accurately computing the depth. When veering, the line between the reel and the leading-block must be kept sufficiently taut, to prevent its running out in bights, that might catch on some projecting object, and thus occasion damage, or possibly a sudden stoppage of the line. Hence, skilful braking requires care, practice, and physical strength. In 1877 I tried a mechanical brake; it proved, however, inefficient, and was used only a few times. When the vessel heaves, the line is run off the reel with great violence, and on her plunging into the trough of a sea, the drag of the lead becomes greatly diminished, nay, for a moment may be taken off altogether. These constant alternations are instantly felt when the braking is done by hand; and with some little practice, the brakesmen can calculate to a nicety the needful amount of pressure, whereas with the mechanical brake we found it impossible to follow the changes, which could not be felt through the machine.

In depths not exeeding 900 or 1000 fathoms, the best way of determining the exact moment when the lead struck the bottom, was to let the line run loosely through the hand, when a sudden disminishment of velocity would be felt. Nay, it could be distinctly *seen*, the line between the leading-block and the reel becoming all at once slack and dropping down on the deck. Having veered to a depth of 700 fathoms, there was no great need of braking to keep the line taut on the remainder of the downward journey. In some few instances, when sounding in from 1100 to 1200 fathoms with the tube-lead alone, we found it impossible to tell exactly when the lead touched the bottom. The line went on running out by its own weight only, and moreover, with a velocity that did not sensibly differ from that given it by the additional weight of the lead. Hence, when accuracy of measurement was the chief desideratum, we had to sound again, and with the Baillie machine Sent down along with Wille's water-bottle, the tube-lead gave good results, as shown at Station 247. Here, the Baillie machine indicated a depth of 1120 fathoms, and the tube-lead used with Wille's water-bottle, 1124.

Determination of Depth. — The line for deep-sea soundings being graduated into hundreds of fathoms, the exact depth had in each case to be computed from special observations. Our mode of procedure was, at first, as follows: — The moment the lead entered the water, as also one of the slips of bunting on the line, an officer called out, and the time to a second was entered in the sounding-journal. To attain greater accuracy, the brakesmen had to give timely notice for every slip of bunting run off the reel; the instant the lead struck the bottom, the officer gave the word, and the time was entered in the journal. From the series of entries was computed the first difference, or set of intervals. These figures increase with the depth, the velocity diminishing with the length of the line running out through the water. The second difference of the series

En anden Methode var at tage Tidsintervaller under Indhivningen af Lodlinen, idet man lod Indhivningsmaskinen gaa saa jevnt som muligt. Herved fik man bestemt det Tidsrum, Maskinen brugte for at tage ind 100 Favne saavelsom det Tidsrum, den med samme Hastighed tog ind Overskuddet over sidste Hundredefavnemærke, og Længden af det sidste kunde saaledes bestemmes ved simpel Proportion. Med jevnt Damptryk og jevn Damptilførsel til Maskinen, hvilke er lettere at holde end jevn Bremsning især i urolig Sø, giver denne Methode gode Resultater. Dens Resultater antoges, naar den anvendtes med de nævnte Forudsætninger, som de definitive, forsaavidt ikke den i det følgende beskrevne Methode kom til Anvendelse. De Lodskud, som i 1876 falde paa Dybderne mellem 100 og 300 Favne, beregnedes udelukkende efter den sidst beskrevne Methode.

Den tredie Methode, der er den sikreste, indførtes først i 1877. Idet Loddet løftedes af Bunden, viste Virkningen af dets Vægt sig paa Accumulatoren, der pludselig strakte sig noget ud. En Mand, som stod klar ved agterste Spiltap, greb i dette Øjeblik paa givet Signal med den ene Haand om halende Part af Linen over Midten af Tappen, og fulgte med Linen, idet denne rulledes op paa Rullen, agterover en paa Dækket afsat Længde af 3 Favne. Naar han kom til agterste Mærke, slap han Linen og raabte „En". Næste Mand greb da fat om Linen ved Tappen, og naar han kom til agterste Mærke, raabte han „To" o.s.v. Idet det sidst udløbne Hundredefavnemærke kom i Vandskorpen varskoedes „Stop". Den søgte Længde af Lodlinen fandtes saaledes ved direkte Udmaaling med en Nøjagtighed af en Brøkdel af en Favn.

Ved de mindste Dybder, for hvilke Lodlinen var mærket for hver 10de Favn, bestemtes det enkelte Favnetal i Regelen ved direkte Udmaaling, dels alene, dels som Control for Tidsintervaller med Indhivningsmaskinen.

Lodning med Baillie-Maskinen. Denne blev gjort i Stand paa Agterdækket lige agtenfor Hytten som før forklaret. Saasnart de nødvendige Forberedelser med Lodlinen og Accumulatoren, de samme som ovenfor beskrevne, var færdig, hexedes Lodlinen til Ringen i Baillie-Maskinen eller til øverste Øjebolt i Vandhenteren og i dette Tilfælde nederste Øjebolt i Vandhenteren til Ringen paa Røret. Linen stivhaltes og lagdes rundt Tapperne paa Indhivningsmaskinen. Med denne løftedes nu, naar Fartøjet var stoppet, det hele over Rækken mellem Hytten og Storvantet (Fig. 14) og firedes ned i Vandet for ikke at komme i Svingning og Berøring med Skibssiden under Fartøjets Bevægelser. Dybvandsthermometrene fastgjordes derefter paa Linen 1 à 2 Favne over Vandhenteren eller Lodderne, hvorpaa man med Indhivningsmaskinen udfirede raskt 200 eller 300 Favne. Maskinen standsedes, Stopper paasattes i Forhaand paa Hyttedækket, Linen kastedes af Spiltapperne og rulledes

from computation by time-intervals almost always proved too high.

Another method practised was to measure time-intervals during the winding in of the line, due care being taken to regulate with the greatest nicety the working of the donkey-engine. We could thus determine both the time required for bringing in 100 fathoms and that needed for hauling in the surplus portion of the line run out after the last 100 fathom slip had reached the water, the length of which was then computed by simple proportion. With an equable steam pressure and an equable supply of steam, which is much easier to keep up, more especially in a rough sea, than uniform manual braking, this method will give good results; and hence, when carefully obtained, we regarded such as final, save when the method described below was also had recourse to. The soundings taken in 1876 that embrace depths from 100 to 300 fathoms, were computed exclusively by this method.

The third method, which is the most trustworthy, was not adopted till 1877. On the lead being lifted from the bottom, its weight tells upon the accumulator, which instantly yields a little to the strain. Then, at a given signal, a man, stationed for the purpose at the after drum of the donkey-engine, laid hold of the line as near as may be above the middle of the drum; and while the leading part was being wound on the reel, went aft with it for a distance of 3 fathoms, which had been marked off on the deck, and thereupon let go, calling out as he did so — „One"! Another man then caught hold of the line above the drum, went the same distance aft, and cried — „Two"! and so on in like manner. The instant the 100 fathom slip last run out appeared above the surface of the water, a man called out — „Stop"! Thus, by actual measurement, we found the length of the line within a fraction of a fathom.

Soundings in shallower water, for which the line was graduated into tens of fathoms, we generally determined by direct measurement, whether taken as independent operations or as a means to test the accuracy of the time-intervals registered when heaving in the lead.

Sounding with the Baillie Machine. — As previously stated, this instrument was got ready for use on the after-deck, just abaft the roundhouse. After arranging, in the manner described above, the sounding-line and the accumulator, we shackled the former either to the ring of the Baillie machine or to the upper eye-bolt of the water-bottle, the lower eye-bolt being in the latter case attached to the ring of the tube. The line was now hauled taut and passed round the drums of the donkey-engine. Then, having deadened the ship's way, we hoisted, by means of the donkey-engine, the whole of the gear over the railing, between the roundhouse and the main shrouds (Fig. 14), and lowered it into the water, to prevent the machine from oscillating and from bumping against the side of the vessel. The deep-sea thermometers were next made fast to the line, 1 or 2 fathoms above the water-bottle or the weight, after which we rapidly veered 200 or 300 fathoms

fast paa Rullen agterud, hvor 2 Mænd stode færdige til at bremse. Derpaa kommanderedes „Lad gaa"! og Lodningen udførtes som ovenfor for Rør-Loddet beskrevet.

Udfiringen af Baillie-Maskinen til 200 eller 300 Favnes Dyb, før man lader gaa, er nødvendig paa Grund af den store Vægt, Lodlinen har at bære, og som vilde gjøre det umuligt med de havende Bremsemidler at kunne regulere Linens Bevægelse. De 200 til 300 Favne Lodline, der ved Operationens Begyndelse allerede er i Vandet, giver saamegen Friktion, at det er Bremserne muligt, om end med Anstrængelse, at holde Rullens og Linens Bevægelse under Kontrol.

Ved Lodning paa større Dyb er det ikke saa let at iagttage det Øjeblik, da Loddet naar Bund, som ved mindre Dybder. Linen lægger sig ikke ned i Dækket, men vedbliver at løbe fra Rullen, efterat Loddet er i Bund, med en Hastighed, der ofte kun er lidet mindre end under Loddets Synken. Ved med udelt Opmærksomhed at følge Linens Fart, navnlig dens Bevægelse gjennem Loddeblokken under Accumulatoren, har man imidlertid et næsten altid sikkert Middel til at observere Øjeblikket, naar Loddet slaar i Bund; man ser da nemlig Blokskivens Rotationshastighed pludselig formindsket. En første Kontrol har man strax deri, at Slakken af Lodlinen nu kan hales ind med Haandmagt, medens det, saalænge Loddet løber, i Regelen vil vise sig ugjørligt ved Haandmagt at standse Bevægelsen. Den sædvanlige Kontrol med Notering af Klokkeslet for hvert Hundredefavnsmærke, som gaar i Vandet, anvendtes jevnlig. Den sidste Kontrol havdes endelig deri, at Accumulatoren i det Øjeblik, Lodrøret (og Vandhenteren) løftedes af Bunden, tydelig strakte sig ud. Fra dette Øjeblik begyndte man, som ovenfor beskrevet, at maale Favnetallet over sidst udløbne Mærke. Naar Øjeblikket, da Loddet slog i Bund, var utvivlsomt at iagttage paa den udløbende Line, viste Methoden med Tidsintervaller for hver 100 udløbne Favne sig ulige paalideligere ved Baillie-Maskinen end ved Rørloddet.

Exempel.

No. 354.	Dato 1878 August 11.
	Bredde . . . . . 78° 1′ N.
Klokkeslet . . 4ʰ 40ᵐ p. m.	Længde . . 6° 54′ E. Greew.
Vind . . . . . N.	Lufttemperatur 3°.0
Styrke 3	Overflade do. 4°.5
Vejr . . . . . Skyet	Dybde . . . . . 1343 e. Fv.
Sø 3	Bund . . . . Biloculin - Ler
Vægt . . . . . 315 Pd.	Karakter . . . Meget godt.

of line with the donkey-engine. The engine was now stopped, the fore part of the line secured with a stopper to an eye-bolt on the deck of the roundhouse, and the after part removed from the drums and tightly wound on the reel aft, where a couple of men stood ready to commence braking. The word being now given to let go, the operation was carried out in the manner described above for sounding with the tube-lead.

Veering the apparatus 200 or 300 fathoms preparatory to letting go, was indispensible with the Baillie machine, owing to the great strain upon the sounding-line, the motion of which would otherwise have been impossible to regulate with the means of braking at our disposal. The friction of the 200 or 300 fathoms of line in the water at the beginning of the operation, enable the brakesmen, though with some little exertion, to command the revolutions of the reel and the motion of the line.

When sounding in greater depths, it is by no means so easy as in water comparatively shallow to tell the exact moment at which the lead touches the bottom. The line will not drop flat on the deck, but go on running off the reel, even after the lead has reached the bottom, and with a velocity but very little inferior to that it had during the descent of the lead. Meanwhile, by closely noting the speed of the line, in particular where it passes through the sounding-block below the accumulator, we have, in the great majority of cases, a sure means of accurately determining the moment when the lead strikes the bottom, the rotation of the sheaf of the block becoming instantly slower. Moreover, the slack part of the line can then be readily brought in by hand, whereas so long as the lead is sinking, it will, as a rule, be found impossible to check its motion by physical strength alone. The usual mode of measurement, by noting down the exact time at which each of the 300 fathom slips entered the water, was frequently adopted. As a final resort, we had the test afforded by the visible extension of the accumulator the instant the sounding-tube and the water-bottle were lifted from the bottom. We then, as stated above, immediately began to measure off the number of fathoms run out after the last slip had entered the water. Provided the arrest of the weight at the bottom could be accurately determined by observing the velocity of the line, the method of measuring by time-intervals, for every 100 fathoms run out, was found to be far more trustworthy with the Baillie machine than with the tube-lead.

Extract from the Sounding-journal.

No. 354.	Date 1878 August 11th.
	Lat. . . . . 78° 1′ N.
Time . . . . . 4 40 p. m.	Long. . . . . 6° 54′ E.
Wind . . . . . N.	Temp. of Air 3°. 0.
Force 3	Do. of Sea 4°. 5.
Weather . . . . Cloudy	Depth . . . . 1343 Fath.
Sea 3	Bottom . . . Biloculina Clay.
Weight . . . 315 pounds	Character . . Very good.

Favne.	Tid.	Interval.	2den Diff.
	M. S.	M. S.	S.
200	16 32		
		0 55	
300	17 27		10
		1 5	
400	18 32		3
		1 8	
500	19 40		9
		1 17	
600	20 57		2
		1 19	
700	22 16		3
		1 22	
800	23 38		19
		1 41	
900	25 19		—5
		1 36	
1000	26 55		2
		1 38	
1100	28 33		1
		1 39	
1200	30 12		4
		1 43	
1300	31 55		
		0 49	
Bund	32 44		

Med det beregnede Interval 1m 47s for Længden 1300 til 1400 Favne findes for det observerede Interval af 49s en Længde af 46 Favne, eller den udledede Dybde 1346 Favne. Ved den nøjere Eftermaaling fandtes 1343 Favne. Paa 78° 2′ N, 6° 44′ E fandt den Svenske Expedition med „Sofia" den 14de August 1868 en Dybde af 1350 Favne. „Sofias" paaværende Plads var omtrent 2 Kvartmil W for „Vöringens", og da Bunden fra Spitsbergen af her skraanede nedad mod Vest er Overensstemmelsen mellem begge Expeditioners Lodninger efter al Sandsynlighed endnu større, end de ovennævnte Tal udtrykker.

Lodlinens Ophaling. Efterat Loddet var kommet i Bund, gaves de medsendte Dybthermometre Tid til at antage det omgivende Vands Temperatur, og derpaa lagdes Lodlinen om Tapperne paa Indhivningsmaskinen. Dens Visning sees af de prikkede Linier i Fig. 14. Fra Fodblokken gik Linen først til agterste Spiltap, derfra frem og tilbage gjennem begge Tappers Furer og endelig paa Rullen. Ophalingen begyndte, og under denne rulledes Lodlinen strax op paa Rullen, saaat den altid var klar til næste Lodskud. Maalingen af Dybden under Ophalingen er ovenfor beskrevet. Indhivningen gik jevnt, og Maskinen bragte 100 Favne Line hjem i Løbet af 3 Minutter.

Naar Loddet nærmede sig Vandskorpen, skede Indhivningen langsommere. Thermometerne toges af Linen, under fornøden Stands i Indhivningen, eftersom de kom over Rækken paa Loddebroen, og tilsidst toges Vandhenter og Lod ind paa denne, hvor de hexedes af. Vandhenteren endevendtes og tømtes af Chemikeren. Bundprøven undersøgtes først, som den laa i Lod-Røret og dens Art noteredes i Loddejournalen. Derpaa toges den ud af Røret og bragtes paa Flasker eller Glas, som forsynedes med Stationens Nummer paa Etiketten. I 1876 brugtes Selterswand-Flasker med Korkeprop, i 1877 og 1878 cylindriske Glas, ca. 10cm høje og brede, der lukkedes med Pergament-

Fathoms.	Time.	Interval.	2nd Diff.
	m. s.	m. s.	s.
200	16 32		
		0 55	
300	17 27		10
		1 5	
400	18 32		3
		1 8	
500	19 40		9
		1 17	
600	20 57		2
		1 19	
700	22 16		3
		1 22	
800	23 38		19
		1 41	
900	25 19		—5
		1 36	
1000	26 55		2
		1 38	
1100	28 33		1
		1 39	
1200	30 12		4
		1 43	
1300	31 55		
		0 49	
Bottom	32 44		

The interval computed for 1300 to 1400 fathoms being 1m. 47s., the interval last observed, 49s., will correspond to a length of 46 fathoms, which, added to 1300, gives a depth of 1346 fathoms. By actual measurement, as described above, we got 1343 fathoms. The Swedish Expedition with the "Sophia," sounding on the 14th of August, 1868, in lat. 78° 2′ N., long 6° 44′ E., registered a depth of 1350 fathoms. The position of the "Sofia" was about two miles to the west of that of the "Vöringen;" and as the sea-bed shelves from the shores of Spitzbergen in a westerly direction past this locality, the agreement shown by the soundings of the two Expeditions is probably even greater than expressed by the above figures.

Heaving in the Line. — The lead having reached the bottom, sufficient time was allowed for the deep-sea thermometers to assume the temperature of the surrounding water, after which the sounding-line was passed round the drums of the donkey-engine, as shown by the dotted lines in Fig. 14. From the leading-block, the line was first led to the after drum, then passed backwards and forwards along the grooves of both drums, and finally on to the reel. Thereupon the heaving in commenced, the line, as it came up, being wound on the reel, ready for the next sounding. Our mode of determining the depth when heaving in the lead has been already described. The line was brought in at the uniform rate of 100 fathoms in 3 minutes.

On the lead nearing the surface of the water, the speed of the donkey-engine was reduced. The needful stoppages, too, were made to detach the thermometers as they came over the rail of the sounding-bridge; and finally, the water-bottle and the lead were taken in here and unshackled. The water-bottle was immediately inverted and emptied of its contents, whereas the sample of the bottom was first inspected *in situ*, and its nature registered in the sounding-journal, previous to being taken out of the tube, from which it was transferred to bottles or jars labelled with the number of the observing-station. On the first cruise, in 1876, we used corked soda-water bottles, but in

papir. Bundprøverne overleveredes derpaa til Kemikernes Varetægt.

Loddernes Udløbshastigheder. Efter de i Loddejournalen indeholdte Data gives her nogle Resultater af Studier over Loddernes Bevægelse under Lodningen.

Rørlod. Som tidligere bemærket, var Lodlinens første 200 Favne inddelt med Mærker for hver 10 Favne. Paa Station 375 gjordes et Forsøg til Bestemmelse af Linens eller Loddets Udløbshastigheder under de første 200 Favnes Udløb, idet Tidsøjeblikkene for hvert 10-Favne Mærkes Gaaen i Vandet noteredes, under det at Bremsningen paa Rullen søgtes holdt saa normal som muligt. Resultatet af dette Forsøg indeholdes i den følgende Tabel.

Favne.	Tid fra „Lad gaa".	Interval.	Hastighed. Favne pr. Sek.
0	0.m 0s		
10	6	6s	1.67
20	12	6	1.67
30	15	3	3.33
40	19	4	2.50
50	25	6	1.67
60	32	7	1.43
70	37	5	2.00
80	44	7	1.43
90	50	6	1.67
100	57	7	1.43
110	1 4	7	1.43
120	1 11	7	1.43
130	1 19	8	1.25
140	1 27	8	1.25
150	1 34	7	1.43
160	1 42	8	1.25
170	1 51	9	1.11
180	1 59	8	1.25
190	2 7	8	1.25
200	2 16	9	1.11

Man ser af Rubrikken „Hastighed i Favne pr. Sek.", at Hastigheden, hvormed Loddet synker, der er lig Nul i det Øjeblik, man „lader gaa", i Begyndelsen er voxende, men naar sit Maximum allerede ved 25 Favnes Dyb, og derpaa er den gjennemsnitlig aftagende med Dybden, idet Linens Friktion i Vandet samtidig med at Bremsningen er lettere at regulere, bevirker en større Modstand mod Bevægelsen.

Af Iagttagelser af Udløbstiderne for 100 Favnemærkerne paa en større Række Stationer findes som gjennemsnitlige Værdier de i den følgende Tabel opførte Tal:

1877 and 1878 cylindrical glass jars, about 4 inches high and wide and covered at the top with strong vellum paper. When ready for storing, the samples of the bottom were left in charge of the chemist to the Expedition.

Velocity of the Lead. — In this Section we give some results obtained by investigating the rate of descent from the data registered in the sounding-journal.

The Tube-lead. — As previously stated, the line was graduated for the first 200 fathoms into lengths of tens of fathoms. At Station 375, we sought to determine the absolute rate of descent down to a depth of 200 fathoms, by registering the exact moment at which each of the ten-fathom slips entered the water, striving the while to keep the braking as uniform as possible. The following Table shows the results of the experiment.

Fathoms.	Time.	Interval.	Velocity. Fath. pr. Sec.
0	0.m 0s		
10	6	6s	1.67
20	12	6	1.67
30	15	3	3.33
40	19	4	2.50
50	25	6	1.67
60	32	7	1.43
70	37	5	2.00
80	44	7	1.43
90	50	6	1.67
100	57	7	1.43
110	1 4	7	1.43
120	1 11	7	1.43
130	1 19	8	1.25
140	1 27	8	1.25
150	1 34	7	1.43
160	1 42	8	1.25
170	1 51	9	1.11
180	1 59	8	1.25
190	2 7	8	1.25
200	2 16	9	1.11

We see from a glance at the column headed "Velocity in fathoms pr. second," that the rate of descent, which at the moment of letting go is nil, tends at first to increase, soon however reaching its maximum, at a depth of 25 fathoms, after which it begins, and as a rule continues, to decrease with the depth, the augmenting friction in the water, along with increased facility of braking, together occasioning greater resistance to the downward motion of lead and line.

The figures in the following Table are deduced from the intervals, timed at a number of Stations, for every hundred-fathom slip that successively entered the water, and represent the average rate of decent.

Favne.	Tid fra „lad gaa".	Interval.	Hastighed Favne pr. Sek.
0	0m 0s		
100	55	0m 55s	1.82
200	2 12	1 17	1.29
300	3 42	1 30	1.11
400	5 18	1 36	1.05
500	7 6	1 48	0.92
600	9 7	2 1	0.83
700	11 15	2 8	0.78
800	13 29	2 14	0.75
(900)	(16 10)	(2 41)	(0.62)

For Intervallet 800—900 Favne haves kun en Observation.

De her fundne Hastigheder slutter sig meget godt til de ovenfor fundne, efter hvilke Gjennemsnitshastigheden mellem 0 og 100 Favne er 1.82 og mellem 100 og 200 Favne 1.28. Man ser endvidere, at Loddets Hastighed er stadig aftagende med Dybden. Udjevner man paa grafisk Vej Hastighederne i den første Tabel og slutter denne Række til den anden, der beror paa flere Iagttagelser, saaledes at Tidsintervallerne i den sidste beholdes, saa faar man et Billede af Rørloddets Bevægelse saaledes som Kurverne R i Fig. 15 og 16 viser. Fig. 15 viser de til de forskjellide Tider udløbne Længder af Lodlinen, og Fig. 16

Fathoms.	Time.	Interval.	Velocity Fath. p. Sec.
0	0m 0s		
100	55	0m 55s	1.82
200	2 12	1 17	1.29
300	3 42	1 30	1.11
400	5 18	1 36	1.05
500	7 6	1 48	0.92
600	9 7	2 1	0.83
700	11 15	2 8	0,78
800	13 29	2 14	0.75
(900)	(16 10)	(2 41)	(0.62)

For the 800—900-fathom interval we have only one observation.

The velocities thus determined agree pretty well with those previously found, which average 1.88 between 0 and 100 fathoms and 1.28 between 100 and 200 fathoms. Moreover, the rate of descent decreases steadily with the depth. Now, if we equalize, in a diagrammatic form, the velocities given in the first Table, and adjust that series to the second, retaining the time-intervals of the latter, as based on a greater number of observations, we shall have figured before us the descent of the tube-lead, as represented by the curves R, R, in Figs. 15 and 16. Fig 15 shows the lengths of sounding-line run out during succes-

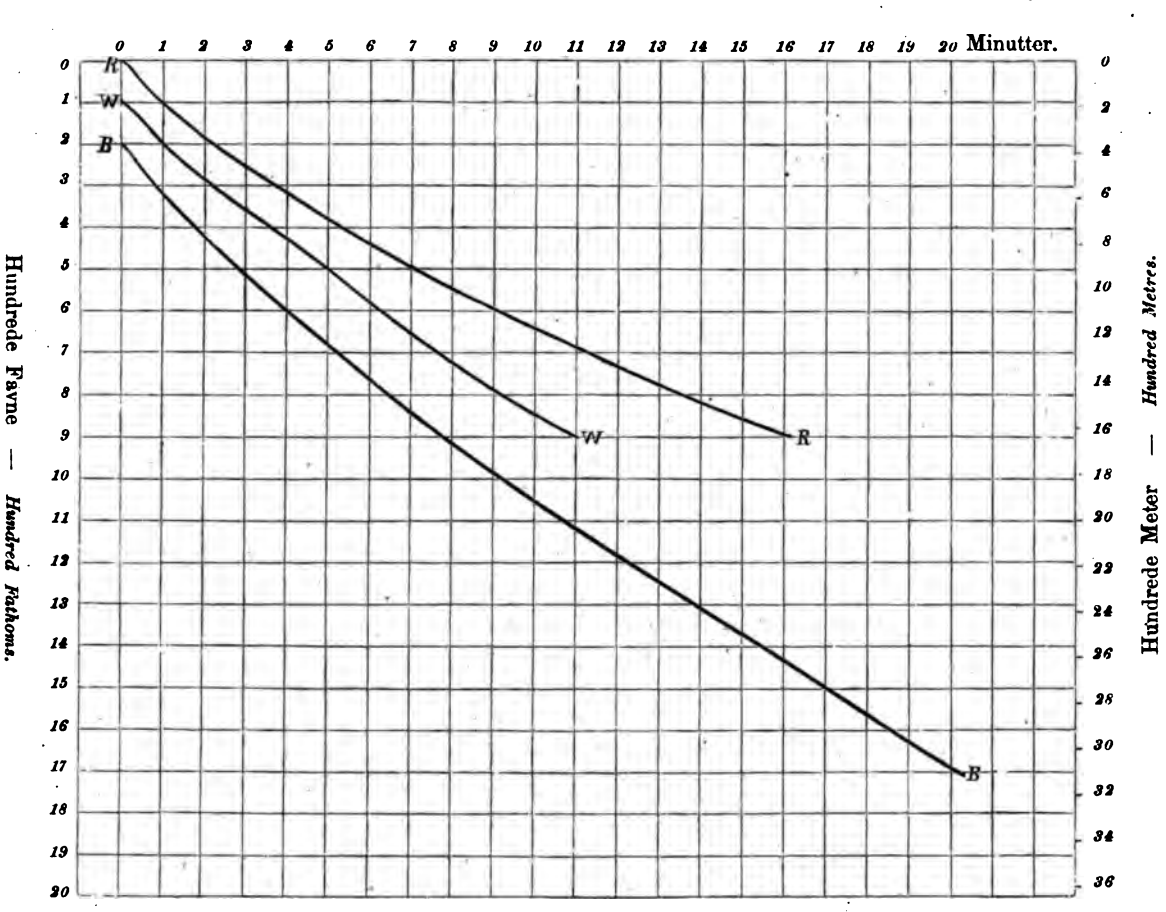


Fig. 15.

Loddet slaar i Bund, er mærkelig større, naar Vandhenteren er paa, end med Rørloddet alene.

Baillie-Maskinen. Den følgende Tabel er Middelresultater af Forsøg med Baillie-Maskinen, med en total Belastning fra 142 til 182 Kilo (285 til 365 Pd.), gjennemsnitlig 171 Kilogram (342 Pd.), efter et større Antal Iagttagelsesrækker.

Favne.	Tid fra „lad gaa."	Interval.	Hastighed Favne pr. Sek.
200	0m 0s		
300	0 51	0m 51s	1.96
400	1 48	0 57	1.76
500	2 50	1 2	1.60
600	3 59	1 9	1.46
700	5 12	1 13	1.37
800	6 27	1 15	1.33
900	7 48	1 21	1.23
1000	9 15	1 27	1.16
1100	10 43	1 28	1.14
1200	12 16	1 33	1.08
1300	13 53	1 37	1.03
1400	15 27	1 34	1.07
1500	17 5	1 38	1.02
1600	18 46	1 41	0.99
1700	20 20	1 34	1.06

Kurverne B i Figg. 15 og 16 viser Tabellens Resultater.

Sammenligner man Kurverne i Fig. 16, saa ser man strax, hvorledes det tungere Lod slaar i Bund med en større Hastighed end det lettere, og Nødvendigheden af tungere Lod til de dybere Lodskud fremtræder med Styrke. Figuren viser tydelig, hvorledes Rørloddet alene kommer til kort paa Dybder over 1000 Favne, saaledes som Erfaringen har vist.

Et fælles Træk for alle tre Hastighedskurver er deres bølgeformige Løb paa større Dybder. Dette forklares ved Bremsningens Ujevnhed. Bremsningen paa Rullen er paavirket af Søgangen, idet den falder lettere at regulere i roligt Vejr end i uroligt, naar Fartøjet løfter og sænker sig og derunder snart rykker i Linen, snart gaar med dens Bevægelse. Men Ujevnheden i Bremsningen er vistnok ogsaa af fysiologisk Natur. Under den første Del af Loddets Udløb bremser Folkene paa Rullen med friske Kræfter og udelt Opmerksomhed. Figuren viser i den tilsvarende Del af Hastighedskurverne den største Regelmæssighed. Saa bliver Bremserne trætte og mindre agtpaagivende. Lodlinen begynder at slænge op og ned og til Siderne paa Vejen fra Rullen til Fodblokken. Et „brems ordentligt" fra den kommanderende Officiers Mund bringer atter Regelmæssighed i Bevægelsen, men denne afløses igjen af Virkningen af Træthed under det fortsatte anstrængende Arbejde og saa fremdeles. Disse Perioder i Hastigheden

that the velocity of the lead when it strikes the bottom is perceptibly greater with the water-bottle attached than without.

The Baillie Machine. — The following Table gives the mean results computed from an extensive series of soundings with the Baillie machine, the total sinking-weight, which varied from 285 to 365 pounds, having averaged 342 pounds.

Fathoms.	Time.	Interval.	Velocity Fath. pr. Sec.
200	0m 0s		
300	0 51	0m 51s	1.96
400	1 48	57	1.76
500	2 50	1 2	1.60
600	3 59	1 9	1.46
700	5 12	1 13	1.37
800	6 27	1 15	1.33
900	7 48	1 21	1.23
1000	9 15	1 27	1.16
1100	10 43	1 28	1.14
1200	12 16	1 33	1.08
1300	13 53	1 37	1.03
1400	15 27	1 34	1.07
1500	17 5	1 38	1.02
1600	18 46	1 41	0.99
1700	20 20	1 34	1.06

The curves B, B in Figs. 15 and 16, are constructed from the results set forth in this Table.

A glance at the curves in Fig. 16, shows that the heavier the lead the greater will be its velocity on reaching the bottom; and hence the need of increasing the sinking-weight for deeper soundings. The diagram clearly discloses the untrustworthiness of the tube-lead as a sounding-instrument for depths of more than 1000 fathoms, thus confirming the result of experience.

A common feature distinguishing the three curves of velocity is their sinuous course in great depths. This must be ascribed to want of uniformity in braking. The said operation is disadvantageously affected in a seaway, the revolutions of the reel being easier to regulate in calm than in rough weather, when the vessel heaves and sinks, now dragging after her the line, and now following its motion. Meanwhile, the cause of irregular braking is in part, no doubt, physiological. The men, who come to their work fresh, brake at first with skill and undivided attention. This is evident from the diagram, which exhibits greatest regularity of form in the corresponding portion of the curve of velocity. After a time, the brakesmen get tired, and in consequence less attentive. The sounding-line is jerked up and down and sideways on its passage from the reel to the leading-block. By an encouraging word, the officer in charge can, indeed, for a time, restore regularity to the braking; but soon the effects of lassitude, brought

Paa Norhavsexpeditionens trende Undersøgelsesrejser toges nedenstaaende Lodskud. Til at betegne Bundens Beskaffenhed er anvendt følgende Forkortelser:

b — blaa, blk — sort, br — brun,
c — grov, cl — Ler, d — mørk,
f — fin, g — Singels, gn — grøn,
gy — graa, h — haard, m — Mudder,
oz — Slik, r — Fjeld, s — Sand,
sft — blød, sh — Skjæl, st — Sten,
B. cl — Biloculin-Ler, y — gul.

On the three exploring cruises of the Norwegian North-Atlantic Expedition, the following soundings were taken. The abbreviations given below denote the nature of the bottom.

b — blue, blk — black, br — brown,
c — coarse, cl — clay, d — dark,
f — fine, g — gravel, gn — green,
gy — grey, h — hard, m — mud,
oz — ooze, r — rock, s — sand,
sft — soft, sh — shells, st — stones,
B. cl — Biloculina clay, y — yellow.

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde. (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde. (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
2	61° 10.′	6° 32.′E	653	672	1229	s & cl	42	63° 2.′	10° 17.′W	256	264	483	r
3	61 5	5 15 E	600	618	1130	do.	43	63 11	13 32 W	514	529	967	s
4	61 5	5 14 E	550	566	1035	s. cl. g	44	63 8	14 0 W	820	844	1543	r
5	61 6	5 12 E	490	504	922	s. cl	45	63 28	12 58 W	370	381	697	r. cl
6	61 6	5 9 E	205	211	386	r	46	63 51	12 5 W	250	257	470	s. cl
7	61 6	5 11 E	200	206	377	r	47	64 13	11 14 W	185	190	347	r
9	61 30	3 37 E	200	206	377	cl	48	64 36	10 22 W	290	299	547	s. oz
10	61 41	3 19 E	214	220	402	oz. cl	49	65 0	9 25 W	425	437	799	s. cl
11	61 47	3 9 E	225	232	424	cl	50	65 26	8 24 W	555	571	1044	cl
12	61 53	3 0 E	217	223	408	cl	51	65 53	7 18 W	1130	1163	2127	B. cl
13	61 58	2 54 E	221	228	417	cl	52	65 47	3 7 W	1808	1861	3403	B. cl
14	62 4	2 45 E	220	226	413	cl	53	65 13	0 33 E	1495	1539	2814	B. cl
15	62 10	2 36 E	215	221	404	cl	54	64 47	4 24 E	584	601	1099	B. cl
16	62 24	2 17 E	215	221	404	r	55	64 38	10 22 E	90	93	170	r
17	62 33	2 4 E	280	288	527	r	56	64 39	10 11 E	173	178	326	s. cl
18	62 44	1 48 E	400	412	753	cl	57	64 39	9 59 E	156	161	294	cl
19	62 23	2 50 E	220	226	413	cl. s	58	64 39	9 49 E	215	221	404	s. cl
20	62 16	3 8 E	213	219	400	cl	59	64 39	9 38 E	162	167	305	s. cl
21	62 14	3 28 E	183	188	344	cl. s	60	64 40	9 30 E	115	118	216	h. cl
22	62 13	3 41 E	125	129	236	cl. s	61	64 40	9 19 E	115	118	216	h. cl
24	63 10	5 58 E	87	90	165	s. cl	62	64 41	9 10 E	105	108	198	h. cl
26	63 10	5 16 E	230	237	433	s. cl	63	64 41	9 0 E	90	93	170	r
	63 7	5 17 E	87	90	165	r	64	64 42	8 50 E	56	58	106	r
27	63 6	5 18 E	85	87	159	r	65	64 42	8 39 E	60	62	113	r
28	63 10	5 11 E	385	396	724	s. cl	66	64 43	8 30 E	85	88	161	s. cl
29	63 10	5 7 E	385	396	724	s. cl	67	64 44	8 19 E	116	119	218	s. cl
30	63 10	5 4 E	390	401	733	s. cl	68	64 44	8 9 E	128	132	241	cl
31	63 10	5 0 E	405	417	763	s. cl	69	64 45	8 2 E	124	128	234	cl. s
32	63 10	4 51 E	418	430	786	s. cl	70	64 45	7 53 E	126	130	238	cl. s
33	63 5	3 0 E	510	525	960	cl	71	64 45	7 46 E	128	132	241	s. cl
34	63 5	0 53 E	570	587	1073	oz	72	64 46	7 37 E	133	137	251	s cl
35	63 2	1 12 W	1000?	—	—	cl	73	64 46	7 28 E	129	133	243	s. cl
	63 7	1 26 W	1050	1081	1977	cl	74	64 47	7 20 E	128	132	241	s. cl
36	62 15	4 34 W	144	148	271	st	75	64 47	7 13 E	141	145	265	s. cl
37	62 28	2 29 W	679	690	1262	s. cl	76	64 47	7 4 E	145	149	272	s. cl
38	63 1	3 58 W	198	204	373	r	77	64 48	6 54 E	145	149	272	s. cl
40	63 22	5 29 W	1180	1215	2222	s. cl	78	64 48	6 45 E	151	155	283	s. cl
41	63 37	7 10 W	677	697	1275	cl	79	64 48	6 36 E	151	155	283	s. cl

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
197	71° 7.′	17° 28.′ E	134	138	252	r
198	71 13	16 52 E	219	226	413	r
199	71 18	16 17 E	510	525	960	r
200	71 25	15 41 E	602	620	1134	br. cl
201	71 31	15 28 E	628	647	1183	br. cl. s
202	71 31	14 40 E	780	803	1468	cl
203	71 31	13 54 E	875	901	1648	br. cl. st
204	70 57	13 34 E	1230	1266	2315	B. cl
205	70 51	13 3 E	1250	1287	2354	B. cl
206	70 45	14 36 E	1212	1248	2282	B. cl
207	70 33	15 50 E	1079	1111	2032	B. cl
208	70 21	16 57 E	656	675	1234	br. cl. st
209	70 19	17 9 E	122	126	230	r
210	70 17	17 20 E	133	137	251	r
211	70 15	17 31 E	125	129	236	s. cl
212	70 12	17 41 E	138	142	260	s. cl
213	70 23	2 30 E	1710	1760	3219	B. cl
214	70 39	0 0	1700	1750	3200	B. cl
215	70 53	2 0 W	1617	1665	3045	B. cl
216	70 58	3 40 W	1196	1231	2251	s. cl
217	71 0	5 9 W	805	829	1516	B. cl
218	71 1	6 0 W	940	968	1770	B. cl
219	71 2	6 51 W	773	796	1456	B. cl
220	71 2	7 26 W	1238?	1275?	2332?	?
221	71 2	7 35 W	1030	1060	1938	r
222	71 2	7 46 W	635	654	1196	r
223	70 54	8 24 W	68	70	128	blk. cl. s
224	70 51	8 20 W	92	95	174	blk. s
225	70 58	8 4 W	189	195	357	blk. cl. s
226	70 59	7 51 W	330	340	622	blk. cl. s
227	71 13	7 33 W	1010	1040	1902	br. cl
228	71 12	8 9 W	906	933	1706	r
229	71 12	8 55 W	711	732	1339	br. cl
230	71 16	9 10 W	830	854	1562	br. cl
231	71 21	9 23 W	1002	1032	1887	br. cl
232	71 10	8 48 W	758	780	1426	br. cl
233	71 8	8 46 W	563	580	1061	br. cl
234	71 6	8 38 W	251	259	474	blk. cl. s
235	70 59	8 55 W	95	98	179	r
236	70 58	9 2 W	151	156	285	blk. s. cl
237	70 41	10 10 W	255	263	481	br. s. cl
238	70 13	10 54 W	821	845	1545	B. cl
239	69 35	11 13 W	1020	1050	1920	B. cl
240	69 2	11 26 W	975	1004	1836	B. cl
241	68 41	10 54 W	1087	1119	2046	B. cl
242	68 36	8 40 W	1003	1033	1889	B. cl
243	68 32	6 26 W	1345	1385	2533	B. cl
244	68 28	4 17 W	1895	1951	3568	B. cl
245	68 21	2 5 W	1948	2005	3667	B. cl
246	68 14	0 6 E	1546	1592	2911	B. cl
247	68 5	2 24 E	1088	1120	2048	y. cl
248	67 56	4 11 E	756	778	1423	B. cl
249	68 12	6 35 E	1033	1063	1944	B. cl
250	68 10	9 20 E		1150?		y. cl. g
251	68 6	9 44 E	616	634	1159	br. cl
253	I Skjærstadfjorden		255	263	481	gy. cl
254	67° 27.′	13° 25 E	139	143	262	b. cl
255	68 12	15 40 E	331	341	624	b. cl
256	70° 8.′	23° 4.′ E	218	225	411	gn. cl
257	70 4	23 2 E	155	160	293	gy. cl
258	70 13	23 3 E	223	230	421	gn. cl
259	70 49	25 59 E	78	80	146	r
260	70 55	26 11 E	123	127	232	cl
261	70 47	28 30 E	123	127	232	cl
262	70 36	32 35 E	144	148	271	cl
263	70 44	34 14 E	117	121	221	cl
264	70 56	35 37 E	84	86	157	sft. cl
265	71 18	34 49 E	102	105	192	h. cl
266	71 27	35 39 E	126	130	238	sft. cl
267	71 42	37 1 E	144	148	271	cl. st
268	71 36	36 18 E	126	130	238	cl. s
269	72 11	36 40 E	134	138	252	gn. cl
270	72 27	35 1 E	132	136	249	br. cl
271	72 38	33 50 E	155	160	293	gn. cl
272	73 11	33 3 E	110	113	207	cl. s
273	73 25	31 30 E	191	197	360	gn. cl
274	73 46	31 16 E	177	182	333	cl
275	74 8	31 12 E	143	147	269	gn. cl
276	74 5	27 39 E	214	220	402	gn. cl
277	74 3	25 43 E	218	225	411	gn. cl
278	74 1	22 27 E	223	230	421	gn. cl
279	74 15	20 48 E	77	79	144	st. sh. cl
280	74 10	18 51 E	34	35	64	r
281	74 3	17 18 E	112	115	210	r
282	73 53	15 36 E	444	457	836	sft. gn. cl
283	73 47	14 21 E	745	767	1403	br. cl
284	73 1	12 58 E	777	800	1463	br. cl
285	73 6	11 56 E	995	1024	1873	br. cl
286	72 57	14 32 E	434	447	817	gy. cl
287	72 52	15 19 E	242	249	455	gy. cl
288	72 46	17 50 E	209	215	393	br. cl
289	72 41	20 18 E	213	219	400	gn. cl
290	72 27	20 51 E	185	191	349	cl. s
291	71 54	21 57 E	188	194	355	gy. cl
292	71 20	22 59 E	210	216	395	gy. cl
293	71 7	21 11 E	92	95	174	s. cl
294	71 35	15 11 E	619	637	1165	sft. br. cl
295	71 59	11 40 E	1078	1110	2030	B. cl
296	72 15	8 9 E	1399	1440	2633	B. cl
297	72 36	5 12 E	1243	1280	2341	B. cl
298	72 52	1 51 E	1457	1500	2743	B. cl
299	73 10	2 14 W	1327	1366	2498	B. cl
301	74 1	1 20 W	1636	1684	3080	B. cl
302	75 16	0 54 W	1928	1985	3630	B. cl
303	75 12	3 2 E	1166	1200	2195	B. cl
304	75 3	4 51 E	1686	1735	3173	B. cl
305	75 1	7 56 E	1545	1590	2908	B. cl
306	75 0	10 27 E	1296	1334	2440	B. cl
307	74 58	12 10 E	1181	1216	2224	B. cl
308	74 57	12 43 E	1104	1136	2078	B. cl
309	74 57	13 18 E	1035	1065	1948	br. cl
310	74 56	13 50 E	977	1006	1840	br. cl
311	74 55	14 25 E	872	898	1642	br. cl
312	74 54	14 53 E	639	658	1203	gy. cl
313	74 55	15 49 E	198	204	373	gy. cl
314	74 55	15 21 E	494	509	931	gy. cl

Temperatur-Rækker.

Til Undersøgelse af Temperaturen i forskjellige Dybder paa samme Station toges Temperatur-Rækker. Disse udførtes i Regelen saaledes: Rørloddet hexedes i Lodlinen, og lige ovenfor Loddet fastgjordes et Dybvandsthermometer, ganske som ved Lodning. Indhivningsmaskinen udfiredes 100 Favne, og Thermometer No. 2 gjordes fast i Lodlinen fra Loddebroen. Atter udfiredes det andet 100 Favne og Thermometer No. 3 paasattes Linen. Paa denne Maade anbragtes 5 a 6 Thermometre paa Linen med 100 Favnes Afstand og sænkedes ved Udfiring fra Indhivningsmaskinen til de Dybder, i hvilke man vilde maale Temperaturen. Naar alle Thermometre havde faaet Tid til at accommodere sig, haledes Linen ind med Maskinen. Der stoppedes saa lang Tid, som var nødvendig for at løse Thermometrene fra Linen, efterhvert som de kom op. Der lagdes megen Vind paa jevne Bevægelser under disse Operationer, for ikke at udsætte Indexthermometrene for pludselige Ryk eller Stød. I høj Søgang maatte der benyttes megen Forsigtighed ved Thermometrenes Aftagning af Linen. Fartøjet laa i Regelen, som ved Lodning, med Stevnen mod Søen, men man kunde ikke altid holde Lodlinen saaledes, at den kunde naaes med Haanden fra Loddebroen. Linen maatte da bringes ind til Broen ved Hjælp af en Baadshage, der maatte gribe Linen *under* Thermometret for ikke at komme til at berøre dette.

Temperaturrækkerne udførtes kun meget faa Gange ved at lade Linen løbe ud fra Rullen, da dens Standsning let medførte Ryk, som ialfald Indexthermometre ikke maa udsættes for.

Temperaturrækker paa Dybder mindre end 50 Favne udførtes ofte med Haandlod og Haandline, der havde Mærker for hver 5 eller 10 Favne.

Temperaturrækkerne toges i Almindelighed strax efter et Lodskud. Flere Gange blev der dog efter Lodskuddet arbejdet med Skrabe eller Trawl, naar saadant faldt belejligere, og Temperaturrækken toges da efter at disse Arbejder var færdige. Paa denne Maade er det gaaet til, at Temperaturrækkens paaværende Plads undertiden er lidt forskjellig fra Lodskuddets.

Varigheden af en Temperaturrække er naturligvis forskjellig efter Antallet af Dybder, hvori Temperaturen tages og efter Dybdernes Størrelse. En Statistik, taget af Skibsjournalen, viser, at der til *Lodskud og Temperaturrække* medgik omtrentlig:

Paa et Dyb af	100	Favne	30 til 50 Minutter.
- - - -	500	—	1 Time 40 —
- - - -	1000	—	2 Timer 30 —
- - - -	1500	—	3 —
- - - -	2000	—	3 -- til 3 Timer 30 Minutter.

Serial Temperatures.

For determining the temperature of the sea in different depths at the same observing-station, we took series of temperatures. Our mode of operation was generally as follows: — After shackling the tube-lead to the sounding-line, we attached, just above the weight, a deep-sea thermometer, precisely as for ordinary soundings. Then, 100 fathoms of line were veered out with the donkey-engine, and Thermometer No. 2 made fast, from the sounding-bridge, at the first hundred-fathom slip, after which we veered another 100 fathoms, and attached Thermometer No. 3 to the line at the second slip. In this manner, as many as 5 or 6 thermometers were made fast to the sounding-line at intervals of 100 fathoms, and sent down to register the temperature in the desired depths. So soon as the thermometers had had time to take the temperature of the surrounding water, we started the donkey-engine and began hauling in the lead, stopping, as each of the thermometers came up over the rail of the bridge, to detach it from the line. Very great importance was attached to uniformity of motion pending these operations, so as not to expose the index-thermometers to any sudden jerk or shock. In a heavy sea, we had to be specially careful when taking the thermometers off the line. The ship generally lay head to sea, as she did during the descent of the lead; nevertheless, we sometimes found it impossible to keep the line within reach from the sounding-bridge, in which case it was got in with a boat-hook, care being taken to hook the line below the thermometer, and thus avoid coming in contact with the latter.

Only a few serial temperatures were taken by letting the line run out of itself, the necessary stoppages in that case easily occasioning jerks, to which the index-thermometers, at least, must not be exposed.

At depths of less than 50 fathoms, serial temperatures were frequently taken with the hand-lead, the line being graduated into fives or tens of fathoms.

As a rule, we took our serial temperatures immediately after sounding. On several occasions however, the dredge or trawl was worked in preference, the serial temperatures being in that case deferred till we had terminated those operations. This accounts for the position in which certain of the serial temperatures were taken differing slightly from that of the soundings.

The time required to take a serial temperature will obviously depend alike on the depth and the number of temperatures. Data obtained from the ship's log-book show the time occupied in taking a sounding and a serial temperature to have averaged as follows: —

For a Depth of	100	Fathoms	from 30 to 50 minutes.
- - — -	500	—	1 hour 40 minutes.
- - — -	1000	—	2 hours 30 —
- - — -	1500	—	3 —
- - — -	2000	—	from 3 hours to 3 hours 30 minutes.

lidte Søskade, benyttede vi Anledningen til at give Læberne en hensigtsmæssigere Form, idet der udenpaa den oprindelige Læbe paaklinkedes tyndere Jernlæber, der rakte 3.9 cm. ($1^1/_2$ Tomme) frem foran de gamle. Mundingen blev herved ogsaa noget videre, da de nye Læber havde en divergerende Stilling udad, foruden at Læberne blev skarpere. I Fig. 17 ser man dem afbildet. Denne Anordning viste sig strax som en Forbedring. Det hændte dog undertiden, at Læberne greb altfor dybt, saaledes at Skraben i kort Tid fyldte sig med Bundmaterialet, istedetfor kun at skumme det Øverste af dette af og først efter længere Tids Skrabning at fylde Sækken. Denne Ulempe hævedes dog snart ved Anbringelsen af et Par korte Træmejer, som er viste i Figuren, paa begge Sider af Skrabens Jernramme. Mejerne var 4 til 5 Centimeter ($1^1/_2$ til 2 Tommer) brede og af lidt større Længde end Jernrammens Højde, paa Ydersiden og for begge Ender afrundede, og fastgjorte henimod sine Ender med Surringer dels til Jern-Hanefoden dels til den Kant af Skraberammen, hvor Sækken var fastsyet. Forenden rakte ganske lidt foran (i Figuren over) Læbernes Yderkant.

Sækken var af Kokostougverk, lagt som Matte. Den var syet til Skrabens Jernramme paa dennes Under- eller Bagside, og desuden sammensyet paa Siderne som vist i Figuren, saaledes at den let kunde aabnes og Indholdet lægges frit i Dagen.

Skraben var, saaledes som Figuren viser, forsynet med en *Hanefod*, i hvilken Skrabetouget blev fastgjort. Hanefoden var af Jernstænger, med dobbelt Part i den Skraben nærmeste Del, og fæstet til Skraberammen med stærke Ringe, der gik gjennem Huller i denne og gjennem Hanefodens Øjebolt. Den ene Side af Hanefoden bestod i Forhaand af 2 Dele, der endte i Øjebolte, som var forbundne med en Fangning af Skibmandsgarn. Denne var beregnet paa at springe, dersom Skraben stødte paa en større Hindring paa Havbunden, som kunde holde den fast, naar begge Hanefodens Arme trak i Skraben. Med alene den ene Arm som Drag. kunde man i mange Tilfælde gjøre Regning paa at faa Skraben halet rundt Hindringen og løs.

Til Sækkens Bund var fastgjort en Jernstang, til hvilken, ud imod dens Ender, nejedes 2 *Svabere* paa hver Side. Disse Svabere var af heglet Hamp, noget over 1^m (3 Fod) lange. Mange Dyr, som ikke eller i lidet Antal kom ind i Skrabesækken, hang fast ved Svaberne, der saaledes var, for visse Dyrearter, et udmærket Fangstapparat.

Enkelte Gange, paa meget ujevn Bund, hvor man vilde risikere at faa Skraben iturevet, brugtes Svabere alene, fæstede til en Jernstang, der med Hanefod var fæstet til Skrabetouget.

havn in the beginning of July 1876, took advantage of the opportunity afforded to modify the construction of the apparatus, with the object of remedying the above-mentioned defect, in which we succeeded, by rivetting on to the outer surface of the scrapers another, but thinner pair (Fig. 17), projecting an inch and a half beyond the former. In this way greater width was given to the mouth of the dredge, the additional pair of scrapers being made to diverge from each other; moreover, they had sharper edges. Our modification turned out a decided improvement. Now and again, however, the scrapers would cut too deep, and soon fill the dredge-bag with matter from the bottom, instead of skimming off a thin layer from the surface and gradually freighting the apparatus. But this drawback we got rid of by fixing to the frame of the dredge, as shown in the figure, a couple of wooden runners, one on either side. These runners had a width of $1^1/_2$—2 inches, and slightly exceeded in length the height of the frame; they were rounded on the outer side and at both ends, and were lashed, near their extremities, to the iron crow-foot, and to the end of the dredge-frame from which the bag depended. The fore part projected a very little beyond the edges of the scrapers.

The *Dredge-bag* — of strong cocoa-nut matting — was suspended from the lower end of the frame, and fastened together at the sides in such manner as to admit of being readily opened to expose its contents.

The dredge, as shown in the figure, was made fast to the dredge-rope by means of a *crow-foot,* consisting of iron rods, two-armed in the part nearest the dredge, and attached to the dredge-frame by strong iron rings, that passed through holes in the frame and through the eyes of the crow-foot. One arm of the crow-foot was in two parts terminating in eyebolts, connected together by a stop of spunyarn, so that in case the dredge got jammed among rocks and stones, a strain less than sufficient to break the dredge-rope would part the stop, alter the position of the dredge, — which would then be attached to the rope by only one arm of the crow-foot, — and probably enable it to free itself.

To the bottom of the dredge-bag was attached a long tranverse iron bar, with a couple of "swabs," or rather bunches of teazed-out hemp, about 3 feet in length, fastened at each of the free ends. Animals that never entered the dredge-bag, or, at best, but rarely and few in number, came up again and again on the tangles, which seem to be singularly well adapted for the capture of certain kinds of marine animals.

Once or twice, on a bottom exceptionally rugged, involving the risk of the dredge being torn or broken, we sent down the tangles alone, attached to an iron bar, which by means of a crow-foot was made fast to the dredge-rope.

Bom-Trawlen (Fig. 19) bestaar af et poseformet, mod Bagenden spidst indsnævret Net, hvis Mundings Overkant er fastgjort til en, 4.m7 (15 Fod) lang, rund Bom af Træ, paa hvis firkantede Ender er indsmøget Jernmejer, 0m.8 ($2^1/_2$ Fod) høje, paa hvilke Apparatet kjøres langs Havbunden. Trawlens Længde fra Midten af Bommen til Spidsen af Nettet er 6m.5 (21 Fod). Den med Blystykker belastede, noget slakke Underkant af Netmundingen er i sine Ender fæstet til Mejernes Underdel og slæber langs Bunden mellem disse, idet den graver mere eller mindre dybt ned i Bundens Materiale. Gjennem en Hanefod af Tougverk, der er fæstet i Øjebolte paa Forkant af Jernmejerne, staar Trawlen i Forbindelse med Skrabetouget. Til Mejerne og til Netspidsen fæstedes ofte Hampsvabere.

Maskerne i Nettet var oprindelig temmelig aabne, saaat det kun kunde holde større Gjenstande tilbage, medens mindre Dyr og det fine Slam gik igjennem. Efter Professor Sars's Ønske blev derfor Spidsen af Nettet foret med finmasket Garn, saaledes at det kunde holde fint Slam. Med denne Forbedring var efter vor Erfaring Bom-Trawlen et udmærket Bundskrabningsapparat. Den fangede baade under hurtigere og langsommere Bevægelse langs Bunden og tog ikke alene Fiske og andre Dyr, der bevæger sig frit i Nærheden af Bunden, men den skummede ogsaa det øvre dyrholdige Bundmateriale af, ja tog endog Stene og det store, indtil 50 Kilograms (100 Pd.) Vægt ind i Nettet.

Bom-Trawlen havde i sin oprindelige Skikkelse ogsaa den Fejl, at hele Systemet kunde svinge sig rundt i Vandet under Udfiringen, og Apparatet kunde saaledes undertiden falde paa Ryggen, med Bommen ned, paa Havbunden. Denne Mangel blev rettet af Skibsfører Grieg ved at hænge et Lod i slak Bugt mellem Mejerne. Fig. 20 viser dette Arrangement. Naar Trawlen begynder at helde fra den rigtige Stilling, i hvilken den blev sendt ud, afslakkes den Del af Touget, der var fast i den Mej, som var nederst. Loddet trak i den anden Part alene og drog den Ende, som var øverst, ned til samme Højde som den anden.

Til *Skrabetoug* brugtes 5 centimeters (2 Toms) Toug de første 2000 Favne og 6.5 centimeters ($2^1/_2$ Toms) i Agterhaanden. Begge Slags var af bedste Sort russisk Hamp, og Prøvetrosserne besigtigede og prøvede ved Carl-Johansværns Værft.

Forberedelser til Bundskrabning. — Disse begyndte i Regelen strax efter at man var færdig paa Bagbord Side med Lodning eller Temperaturrække.

For at compensere Virkningen af Skibets og Skrabens Bevægelse paa Stramningen af Skrabetouget, navnlig for at undgaa farlige pludselige Ryk, var Skrabetouget vist gjennem en Blok, der hang i en *Accumulator*. Skrabeaccumulatoren var meget større end Loddeaccumulatoren. Den havde 30 Stropper, af samme Slags som de ved Lodningen benyttede. Træskiverne, gjennem hvilke Tougstjerterne gik, havde en Diameter af 0m.605 (1 Fod $11^1/_2$ Tomme) og en Tykkelse af 0m.050 (1.9 Tomme). Skrabeblokken var af

Fig. 19 represents the *Beam-trawl* used on the Expedition. A conical netted bag is suspended by one side from a round beam of wood 15 feet in length, to the square ends of which are fixed iron runners, 2 feet and a half high, that support the apparatus when riding over the bottom. The length of the trawl, measured from the middle of the beam to the apex of the bag, is 21 feet. The lower side of the mouth of the net, weighted with rolls of sheet-lead, hangs loose, and is fastened at either end to the bottom part of the runners, between which it drags along the sea-floor, scooping up more or less of solid matter. This trawl is attached to the dredge-rope by means of a rope crow-foot, lashed to eyebolts on the fore part of the iron runners. We often fastened hempen tangles both to the runners and to the end of the bag.

The commercial trawl, as furnished by the English maker, had a rather wide-meshed bag; and hence it brought up none but comparatively large bodies, small animals and fine mud being washed through. At the instance, therefore, of Professor Sars, the bottom of the bag was lined up to a certain height with yarn netting, sufficiently close to retain the finest mud. With this slight modification, we found the beam-trawl a most efficient instrument, whether quickly or slowly worked; it not only secured fishes and other marine animals that occur near the bottom, but skimmed off a thin layer of the surface; nay, it would take in stones, some of them weighing as much as 100 pounds.

In its original form, the beam-trawl was apt moreover to capsize in the water and reach the bottom with the beam down. Captain Grieg remedied this defective tendency by suspending one of the cast-iron sinkers in a slack bight between the runners. This arrangement is shown in Fig. 20. So soon as the trawl begins to incline from the right position given it at the commencement of the operation, the part of the rope made fast to the runner then deepest in the water will get slack, and the weight accordingly act only upon the runner at the opposite end of the beam, pulling it down to a level with the lower one.

The *Dredge-rope*, samples of which had been examined and tested at the Royal Dockyard of Carljohansværn, was of the best Russian hemp. The 2000 fathoms next the dredge were 2 inches in circumference, the remainder had a circumference of $2^1/_2$ inches.

Preparations for Dredging. — As a rule, the gear was got ready immediately after taking — on the port side — a sounding or a serial temperature.

With a view to take off the suddenness of the strain on the rope caused by the scraping of the dredge or the motion of the vessel, the rope was rove through a block suspended to an *accumulator*. The accumulator provided for the dredge exceeded considerably in size that used with the sounding-machine. The number of straps was 30, and the wooden disks through which the lanyards passed had a diameter of 1 foot $11^1/_4$ inches and a thickness of 2 inches. The dredging-block was of iron, similar in con-

Farten standsedes. Med Stjerten haledes Skrabetouget atter ind til Hakkebrættet og holdtes inde med Bugten af en Ende. Til Stjerten i Pukkenholtskousen fastgjordes en efter Dybden afpasset Vægt, hvortil brugtes 3 eller 4, til de større Dybder 6 af Baillie-Maskinens Lodder, der vejede 27 Kilogr. (55 Pd.) hver. Man slap Tampen af Enden, væltede Vægten overbord, og denne løb da med Kousen nedover langs Touget, indtil den standsedes af den paasatte Trætærs. Dette kunde føles, naar man holdt Haanden paa Touget.

Skibet laa nu stille, medens Lodder og Skrabe sank. Vi regnede, efter flere Forsøg, at der behøvedes 12 Minutter for at Skraben skulde synke 100 Favne. Skråbens (eller rettere Trawlens) og Loddernes Synkning er anskueliggjort i Fig. 20. Den i Figuren antagne Dybde er 1300 Favne, følgelig er Skib og Trawl tegnet i forstørret Maalestok. De prikkede Linier viser Loddernes, Skrabetoughexens og Trawlbommens Bane under Synkningen, under Forudsætning af, at Trawlen synker med en Hastighed, der er lidt mindre end den, hvormed Lodderne nærmer sig Bunden. Idet Lodderne naar Bund, sværer endnu Trawlen i Vandet, og det sidste Stykke af dens Bane vil være næsten lodret. Erfaring viste, at Trawl og Skrabe med den brugte Fremgangsmaade i Regelen uden Vanskelighed kom i rigtig Stilling paa Bunden. Er Skrabens (Trawlens) Synken meget langsommere end Loddernes, vil den falde lodret ned paa Bunden med sin tunge Ende foran. Er derimod dens Synnot less than double the depth, nay for smaller depths even more.

The engine was now stopped, after which we hauled in the dredge-rope, as before, to the taffrail, and kept it up in a bight of rope's end. With the lizard was then made fast to the wooden thimble a weight proportioned to the depth, consisting of 3 or 4, and for the deepest dredgings, of as many as 6 of the sinkers of the Baillie sounding-machine, weighing each 55 pounds. We now, after letting go the rope, tilted the weight overboard, which spun down along it till stopped by the wooden toggle. The shock of its arrest was distinctly perceptible to a person who had his hand on the rope.

The vessel was now kept stationary, while the weight and the dredge were sinking. After some experience, we calculated the time required for the dredge to sink 100 fathoms, to be about 12 minutes. Fig. 20 will

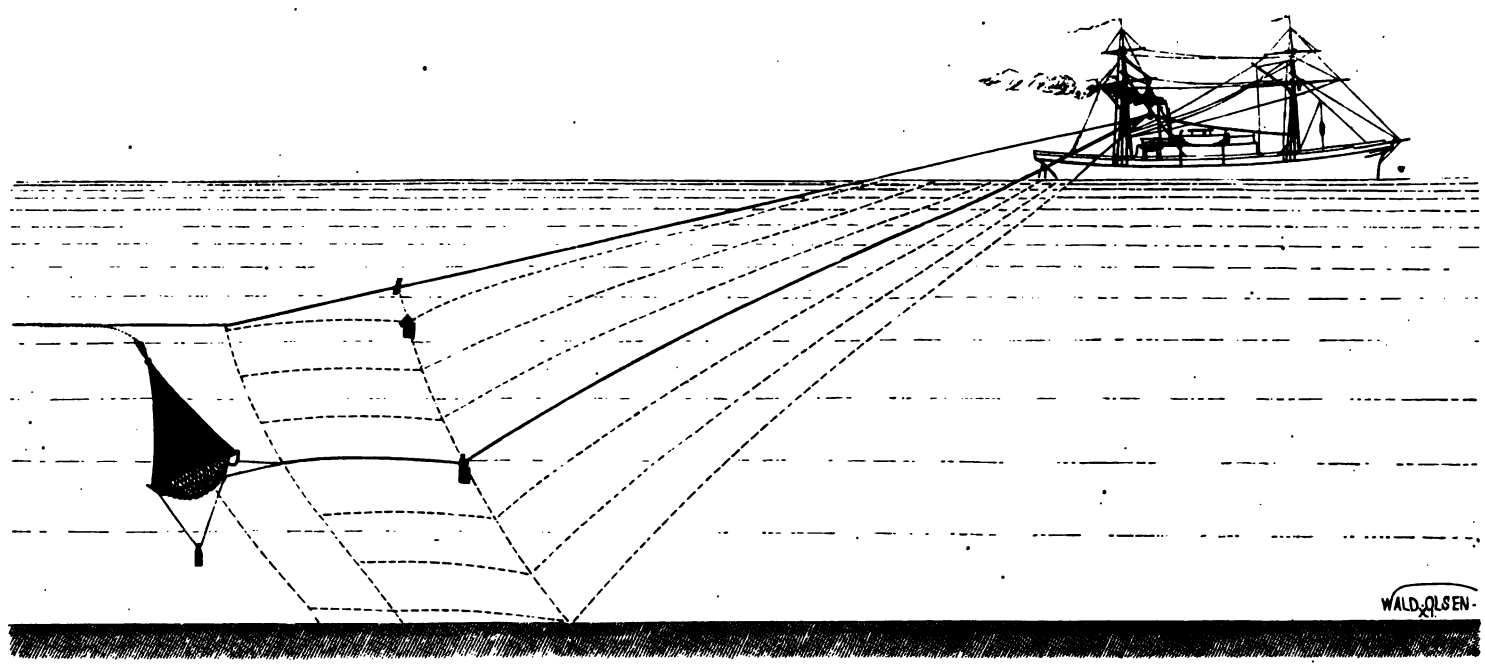


Fig. 20.

give an idea of the descent of the dredge, or rather of the trawl. The supposed depth in the diagram being 1300 fathoms, the vessel and the trawl are of course on a much larger scale. The dotted lines represent the lines of descent of the weight, the shackle, the dredge-rope, and the beam of the trawl, — assuming the trawl to sink more slowly than the weight. When the weight strikes the bottom, the trawl has still some distance to travel, and the last part of its line of descent will be well-nigh perpendicular. We found that, when worked in the manner described above, both trawl and dredge could as a rule without difficulty be made to reach the bottom in the right position. If the dredge or trawl descend much more slowly

ken ligesaa hurtig som Loddernes eller hurtigere, vil den komme til Bunds med en horizontal Component i sin Bevægelse, hvilket vistnok vilde være det sikreste Middel til at den blev klar under den følgende Bundskrabning.

Saasnart Skraben antoges at have naaet Bund, kastedes Touget los forud og Bugten brägtes agterover, lagdes ind i Fodblokken (a, Fig. 2) i Agterkant af Hytten og derpaa om Spiltapperne om Styrbord, saaledes som Fig. 1 viser.

Med 1, $1^1/_2$ og 2 Knobs Fart og samme Kurs som tidligere blev nu Skraben trukket henover Havbunden, idet Vægten i Forhaand holdt den første Del af Touget ned, saa at Draget blev horizontalt eller næsten horizontalt, og Skrabemunden ikke let løftedes fra Bunden. Under Skrabningen maatte man stadig have Opmærksomheden henvendt paa Accumulatoren. Dens Udvidelse og pludselige Sammentrækning igjen angav, naar Skraben tog Tag og atter slap Bunden, og selvfølgelig angav den ogsaa, naar Skraben satte sig fast. Naar Accumulatoren i dette Tilfælde havde udvidet sig saa meget, at man i den lave Stilling, som Loddeblokken indtog, ikke vilde have mere Kraft paa Touget, kommanderedes "Fir"! og Maskinisten ved Indhivningsmaskinen, som for dette Tilfældes Skyld altid stod klar, reverserede Maskinen og firede ud, paa samme Tid som Skibets Fart standsedes. I Regelen fik man Skraben løs ved at hive ind igjen paa Touget. Stod Accumulatoren stadig paa samme Mærke, antydede dette som oftest, at Farten var for stor, og at baade Vægt og Skrabe slæbtes gjennem Vandet fri af Bunden. For at have et Varsko, naar Accumulatoren pludselig udvidede sig over den tilbørlige Grændse, fastgjordes undertiden en Line med den ene Ende i Accumulatoren og med den anden i Damppiben, der saaledes peb, strax Accumulatoren blev for lang.

Skrabningen fortsattes ofte indtil et Par Timer, førend man begyndte *Indhivningen*. Under denne var Farten standset, og man lod Skibet drive tilbage. I Regelen foregik Indhivningen hurtigere end Skibet drev, saa at Touget viste klart ud i Læ. I modsat Fald gik man rundt med Fartøjet, lagde sig paa Læ Side af Touget og drev da tilsidst over Skraben.

Med fuld Fart paa Indhivningsmaskinen tog den ind 100 Favne i 6 à 7 Minutter. Var Skraben meget tung, maatte der hives langsommere. Eftersom Touget kom ind, haledes det fra Spillet over Hytten forefter og blev atter opskudt klart i Bingen forud. Dette var et meget anstrængende Arbejde, navnlig naar Indhivningen, som enkelte Gange Tilfældet, gik uden Stands i 4 til 5 Timer.

than the weight, it will fall vertically, with the heavy end foremost. If, on the other hand, its rate of descent be equal to or exceed that of the weights, it will, on reaching the bottom, have a horizontal component in its motion, — which is pretty sure to keep it from clogging during the ensuing operation.

So soon as the dredge, by our calculation, had reached the bottom, the rope was cast off forward, the bight brought aft, rove through the leading-block (a, Fig. 2) on the after part of the roundhouse, and then passed round the starboard drums, as shown in Fig. 1.

Steaming ahead at the rate of 1, $1^1/_2$, or 2 knots, on the same course as before, the dredge was pulled along the bottom, the tension of the motion of the vessel not however acting immediately upon it, but dragging forward the iron sinkers, which by their great weight serve to keep the direct traction horizontal, or nearly so, and thus prevent the mouth of the dredge from being readily lifted up. In dredging we had to keep our attention constantly fixed on the accumulator. Its extension and sudden contraction was a sure sign that the dredge was working properly, and of course the accumulator also told us when the dredge had fouled the bottom. A great and increasing strain upon the rope, pulling down the block and seriously stretching the accumulator, showed the dredge to have stuck fast, in which case we gave the word to veer, and an assistant engineer, who always stood ready for that purpose, reversed the donkey-engine and paid out the rope, the ship's way, too, being immediately deadened. By hauling in the rope we generally succeeded in extricating the dredge. Sometimes, the accumulator would remain stretched at the same point, and this we as a rule found to indicate that the speed of the vessel was too great, both weight and dredge being dragged through the water clear of the bottom. To give notice of any sudden stretching of the accumulator beyond the safe limit of extension, we hit on the expedient of fastening one end of a line to the apparatus and the other to the steam-whistle, which in that case would sound on the elastic bands running out too far.

Dredging from the "Vöringen" was frequently carried on for a couple of hours before *heaving in*. During the latter operation the vessel drifted before the wind. The rope being in the majority of cases brought in at a rate exceeding the drift of the ship, pointed leeward. If not, we steamed the vessel round, to get the rope to windward and drift over the dredge.

Working at full speed, the donkey-engine brought in 100 fathoms of dredge-rope in 6 or 7 minutes. When the dredge had got a very heavy freight to bring up, we heaved at a slower rate. As the rope came in, we hauled it from the drum of the engine over the roof of the roundhouse, and thence forward into the locker, where it was again coiled ready for the next operation. This was very fatiguing work indeed, particularly when the engine, as was

Naar Lodderne kom op, haledes Bugten af Touget ind til Loddebroen, hvor Vægten blev afstukken. Et godt Mærke paa, at Skraben havde været i Bund, var det, naar Lodderne var overtrukne med Bundler. Naar Skraben kom op, ihukedes et Takkel fra Gaffelen, og med dette løftedes den ind over Agterdækket.

Bundskrabning med Otter-Trawl. Naar man havde faaet denne klar ud i Søen, saa at Otterne skar ud og Nettet slæbte klart efter, foregik Operationerne som med Skrabe. Apparatet var imidlertid vanskeligt at faa klart til Bunds. Det behøvede en større Hastighed under Skrabningen, tog ikke meget af Bunden med og kom ikke sjælden uklart op. Det brugtes derfor efterhaanden mindre og blev det sidste Aar ganske fortrængt af Bom-Trawlen.

Bundskrabning med Bom-Trawl. Fra Agterdækket løftedes Bom og Mejer ud over Rækken ved en Jolle fra Gaffelen. Denne Jolle var fastgjort med en Tærs til en Strop paa Midten af Bommen. Dette gjordes, medens Skibet havde fuld Fart forover. Naar Bommen var kommen i den rette Stilling udenfor Rækken, standsedes Maskinen, Nettet kastedes ud, og man rykkede Tærsen ud ved en deri fastgjort Stjert, hvorefter Udfiringen af Skrabetouget begyndte. De videre Manøvrer var de samme som med Skraben, kun maatte Farten under Skrabningen være mindre, for at Trawlen skulde holde sig i Bund. En større Fart antoges at være hensigtsmæssig til at fange Fiske og anvendtes oftere en kortere Tid efter den egentlige Bundskrabnings Afslutning.

Naar Bomtrawlen kom op fuld af Bundler i hele sin nedre Del, maatte særegne Foranstaltninger til for at faa den ind paa Dækket, dels paa Grund af dens Længde dels paa Grund af dens Vægt, der var for stor til at dens nedre Ende kunde løftes ind med Haandmagt. Den fyldte Trawl havde Form af en Tragt, hvis Spids var udvidet til en Kugle af en Meters (3 Fods) Diameter. I dette Tilfælde sloges Stropper om selve Trawlnettet saa langt nede som muligt, og i disse hukedes Talje fra Gaffelen. Naar Trawlen med denne var løftet saavidt, at kun den nederste kugleformede Del var i Vandet, firedes ned under denne en "Indretning", bestaaende af en tyk Jernring, indvendig udforet med et meget stærkt Tougnet og som hang i 3 Ender, i hvilke man halede ombord under Indløftningen. Denne Sikkerhedsindretning, hvis Hensigt nærmest var at forhindre, at Trawlnettets nedre Ende skulde revne, naar den kom ud af Vandet, idet den bar en Del af Trawlnettets Vægt, var til stor Betryggelse og Hjælp ved at faa Trawlen ombord. Det hændte os ikke nogen Gang, at Trawlen aabnede sig selv under Indholdets Tryk; men før Indretningen kom i Brug, vovede vi ikke at hale Trawlen ombord, førend en stor Del af det fine Bundslam var udslemmet ved Trawlens Svingninger i Vandet.

often the case, had to be kept going for 4 or 5 hours at a stretch.

On the weights coming up, the bight of the rope was hauled in to the sounding-bridge, where they were severally detached. If covered with clay, it was a sure sign that the dredge had been at the bottom. When the dredge appeared, we hooked a tackle on to it from the gaff, by means of which the apparatus was got in on the after-deck.

Working the Otter-Trawl. — Once properly in the water, with the "otters" sheering out to either side, and the bag behind horizontally extended as the instrument was pulled along after the vessel, we worked the otter-trawl precisely as the dredge. The apparatus was, however, apt to foul before reaching the bottom, greater speed being requisite to work it; besides, it failed to secure a satisfactory sample of the bottom, and came up frequently foul. Hence, on discovering these drawbacks, we came to use it less; and on the last cruise it was entirely superseded by the beam-trawl.

Working the Beam-Trawl. — The beam and runners were hoisted over the railing of the after-deck by means of a whip from the gaff, secured with a toggle to a strap on the middle of the beam, — the vessel steaming ahead the while at full speed. So soon as the beam had been given the right position for letting go, the engine was stopped, the bag pitched out, and the toggle pulled off the strap by means of a lanyard, to which it was attached. This done, we began veering the rope. The remainder of the operation was the same as with the dredge, saving the speed, which we had to reduce lest the trawl should be lifted off the bottom. For catching fish, some increase in speed was presumed to be of advantage, and frequently tried as a wind-up to the bottom-trawling.

If the beam-trawl came up with the whole of the lower part filled with clay, special provision had to be made for getting it in, partly on account of its length, and partly owing to its great weight, which would not admit of lifting in the lower part by hand. With the bag full of clay or mud, the trawl had the shape of a cone, expanded at the apex into a sphere, 3 feet in diameter. A bight of rope was passed round the trawl-net as low down as possible, and a purchase hooked on from the gaff. Then, after hauling up the apparatus till the only part left in the water was the spherical extremity of the bag, we lowered under the latter a contrivance consisting of a thick iron ring, having the opening covered with strong cord netting, and the shank firmly secured to 3 stout hempen ropes, by which the apparatus was lifted over. This precautionary device, the main object of which was to prevent the trawl-bag, on its leaving the water, from bursting at the bottom while partially supporting the net and its contents, proved a safe and most efficient expedient for getting the instrument on board. On no single occasion did the bag give way from the pressure of its freight, whereas previous to our adoption of the contrivance, we had never dared to haul in the apparatus till

hivningen, at Skrabeposen eller Trawlnettet lagde sig foran Aabningen og tilstoppede denne. Det første Aar brugtes mest Skrabe, hvortil tildels det uheldige Vejr var Grunden, enkelte Gange Ottertrawl og sjælden Bomtrawl. Det andet Aar kom Bomtrawlen i Brug ved Siden af Skrabe, medens Ottertrawlen heller ikke sjælden benyttedes. Det tredje Aar var Bomtrawlen vort Hovedapparat, som da var forsynet med alle de ovenfor nævnte Forbedringer, og brugtes overalt, selv paa de største Dybder, hvor Bunden var jevn og blød. Paa ujevn og haard Bund fik Skraben sin Anvendelse, hvorimod Ottertrawlen ikke blev benyttet.

Naar Skraben eller Trawlen var kommet ombord, begyndte Zoologernes og deres Assistenters Arbejde. Før Apparaterne kom ombord, fyldtes to store Baljer agterud med Søvand ved Hjelp af Donkeyen (en Hjælpepumpe i Maskinen). Til Sigtning af det optagne Bundmaterial brugtes et Sæt runde Sigter, hvert bestaaende af 3 saadanne, den ene staaende inde i den anden. Den underste Sigt havde en Diameter af 0.^{m}365 (1 Fod 2 Tom.), den mellemste af 0.^{m}33 (1 Fod 1 Tom.) og den øverste af 0.^{m}284 (11 Tom.) Paa alle 3 var Kantens Højde 0.^{m}087 (3$^{1}/_{3}$ Tom.) Maskerne var dannede af Kobbertraade og Aabningen mellem dem var paa den nederste Sigt 0.^{mm}3 til 0.^{mm}5, paa den mellemste 1.^{mm}5 og paa den øverste 2.^{mm} (1 Linie). Sigterne var forsynede med opstaaende Haandtag paa begge Sider.

Naar Skraben kom ombord, afkappedes først Svaberne og derefter blev den firet ned paa Dækket. Sømmen i Sækken blev opsprættet paa begge Sider, og den løsnedes ligeledes fra Jernrammen paa den Side, som laa op. Sækkens Overdel toges af, og Indholdet laa afdækket klart til at tages under Behandling. Fiske, Stene og større Gjenstande udtoges strax til Opbevaring og nærmere Bestemmelse. Med en Øse, hvis Bund var af Metalnet, toges af Assistenterne en Portion af Bundmaterialet op i den øverste af et Sæt Sigter. Dette sænkedes ned i Vandet i en af Baljerne, Sigterne bevægedes op og ned, frem og tilbage, indtil det fine Slam var udslemmet, hvorpaa alle Sigters Indhold undersøgtes af samtlige Zoologer. Naar Skrabesækkens hele Indhold paa denne Maade var undersøgt, skylledes Sækken ren med en Vandstraale fra Donkeyen og gjordes klar til senere Brug. Svabernes Indhold udtoges af Zoologerne, et Arbejde, hvortil der i de fleste Tilfælde maatte benyttes Sax. Af saadanne havdes et større Antal i Reserve.

Trawlens Indhold af Bundmateriale tømtes paa Dækket derved, at man løste op Sammensnøringen i Enden af Bunden.

Den Tid, som en Bundskrabning tager, er væsentlig afhængig af Dybden, foruden naturligvis af den Tid, hvori den egentlige Bundskrabning foregaar. En Statistik herover,

when heaving in the gear, and the bag of the dredge or trawl was apt at times to twist round and clog the mouth of the instrument. On the first cruise, in 1876, partly because of the boisterous weather, we made chief use of the dredge, working the otter-trawl occasionally; the beam-trawl was seldom sent down. On the second cruise, both the beam-trawl and the dredge were in constant use, and we also worked the otter-trawl with comparative frequence. On the third and last cruise, the beam-trawl, with the various modifications before described, had come to be our principal apparatus; indeed, we used it exclusively in every locality, even at the greatest depths, on a smooth and soft bottom. Where the bottom was hard and rugged, we had recourse to the dredge. Of the otter-trawl, no use whatever was made in 1878.

So soon as the dredge or trawl was hauled on deck, our naturalists and their assistants set to work. Shortly before the apparatus was got in, two large tubs on the the after-deck were filled with sea-water by means of the steam-pump. For sifting the contents of the bag, we had a set of 3 sieves, fitting freely one within the other The third or bottom sieve had a diameter of 1 foot 2 inches; the second of 1 foot 1 inch; and the first of 11 inches. The depth was the same in each — 3$^{1}/_{3}$ inches. These sieves were made of copper wire, the bottom sieve with 0.02 inch meshes, the second with 0.075 inch meshes, and the first with 0 1 inch meshes. Each sieve was provided with a pair of vertical iron handles.

Having hauled the dredge over the railing, the first thing we did was to cut off the hempen tangles, and then lower the apparatus on deck. After ripping open the seam of the bag, the netting, on the side lying up, was detached from the frame, and the top part of the bag removed, thus exposing the contents. Fishes, stones, and all larger bodies were at once laid aside, to be stored for subsequent examination. With a ladle having the bottom of brass wire netting, the assistants transferred to the top sieve part of the sample of the bottom brought up in the apparatus. The set of sieves were then moved gently up and down — from side to side — in one of the tubs of water, till the fine mud or ooze had passed through each, after which the three naturalists carefully examined the sieves in succession. When the whole contents of the dredge or trawl had been sifted and examined, the bag of the apparatus was thoroughly rinsed, by directing on to it a jet of water from the steam-pump, and then put by ready for use. The delicate organisms brought up on the hempen tangles had mostly to be clipped out with short scissors, of which there was an ample supply.

For emptying the trawl, we had a contrivance by means of which the bottom of the bag was made to unlace, and the contents could thus be deposited on deck without inverting the apparatus.

The time occupied in a dredging is mainly dependent on the depth, but of course to a considerable extent also on the length of the interval devoted to working the in-

I 1876 anvendtes, foruden den almindelige *Log* med Flyndre og Line. ogsaa Masseys Patentlog. Denne viste sig ikke synderlig hensigtsmæssig paa Grund af de hyppige Standsninger, og et Par Exemplarer gik i Skruen og tabtes. Der savnedes ogsaa god Lejlighed til at kontrollere dens Nøjagtighed. I 1877 indsattes den af Premierlieutenant *M. Petersen* arrangerede *Vandlog,* hvis Anordning

On the first cruise, in 1876, we used Massey's patent log, as well as the common log with logchips and line. The first instrument, however, did not answer well, owing to the frequent stoppages; and on one or two occasions it fouled the screw, and was lost. Moreover, we had no good opportunity whereby to test its accuracy. In 1877, the "Vøringen" was furnished with a *water-log,* the inven-

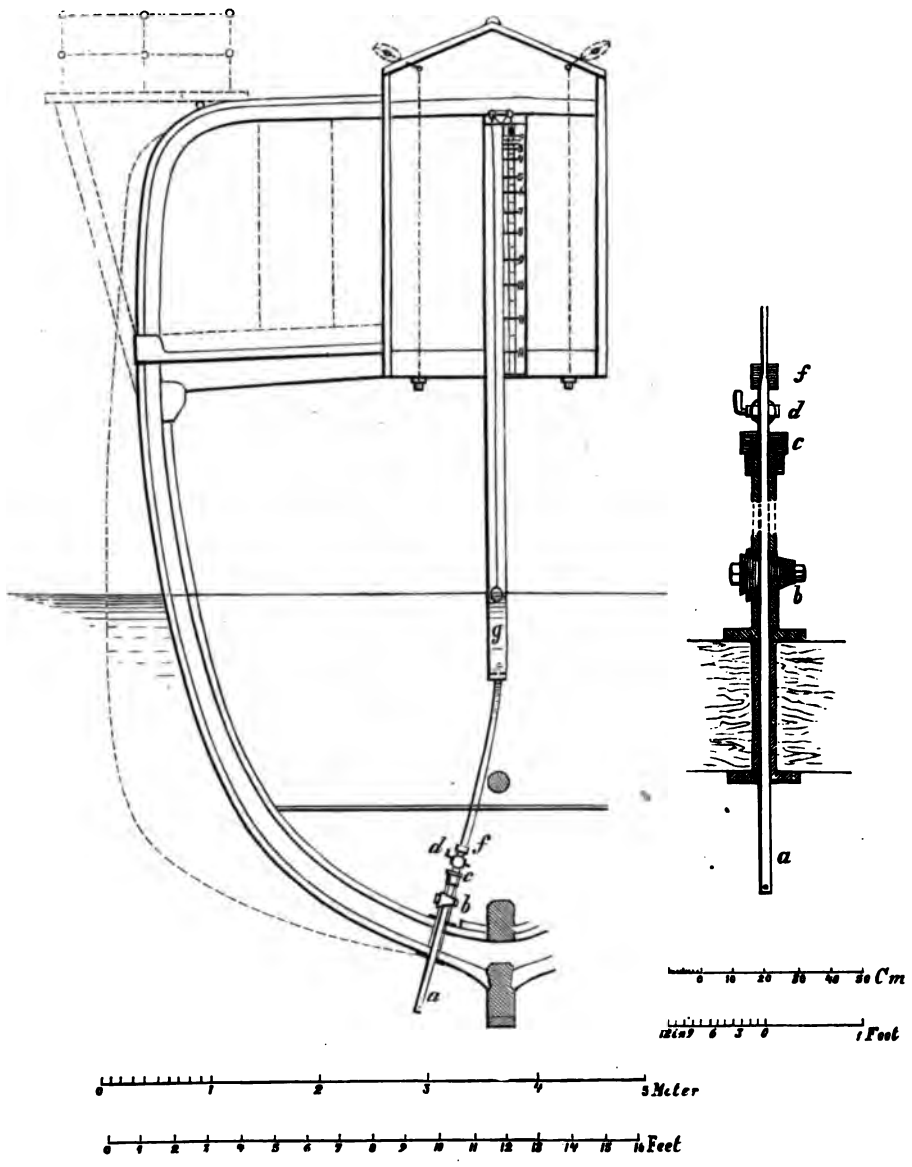


Fig. 21.

ombord i "Vøringen" sees af Fig. 21, der viser et Tversnit af "Vøringen" gjennem den agterste Del af Maskinrummet, seet forfra agterover. Vandloggen har følgende Indretning.

Paa et bekvemt Sted i Maskinrummet bores et Hul i Skibsbunden og fores med et 1 Toms Rør. Over dette anbringes med Flens Røret *b* (se den lille Figur) saaledes, at Aabningen i dette danner en Fortsættelse af Hullet i Bunden. Paa Midten af dette Rør er en konisk Kran og omkring dets øvre Ende er Skruegjænger til Pakningsringen *c*. Gjennem Røret *b* og Hullet i Skibsbunden nedsættes Røret *a* saa langt, at den lille Aabning i dets nedre Ende,

tion of Lieutenant *M. Petersen*. Fig. 21. representing a transverse section of the after part of the engine-room, as seen looking aft, shows the arrangement of the water-log on board.

In some convenient spot in the engine-room, a hole was bored in the ship's bottom to receive a one-inch metal tube, having fixed on to its top end the flange of the tube *b* (see small Figure), in such manner that the bore of the latter would form a continuation of the hole in the ship's bottom. This tube had a conical stop-cock, and its upper extremity screw-threads fitting into the gland *c*. The tube *a* was passed through the tube *b* and the hole in the ship's

Sættes Coefficienten M lig 1, Kvartmilen lig $^1/_{60}$ af en Ækvatorsgrad og g lig 9.^{m}810 (50° N. Br.), saa faar man den følgende Tabel for Skalaens Inddeling.

ficient M to equal 1, a mile to equal $^1/_{60}$ of an equatorial degree, and g to equal 9.810^m (in lat. 50° N.), we have the following series of figures for graduating the scale.

Fart. (Speed.)	Skala. (Scale.)			Fart. (Speed.)	Skala. (Scale.)		
Kvartmil i Timen. (Miles an Hour.)	Meter. (Metres.)	Norske Fod. (Norw. Feet)	Eng. Fod. (Eng. Feet.)	Kvartmil i Timen. (Miles an Hour.)	Meter. (Metres.)	Norske Fod. (Norw. Feet.)	Eng. Fod. (Eng. Feet.)
1	0.014	0.043	0.044	7	0,663	2.114	2.176
2	0 054	0.172	0.178	7.5	0:761	2.427	2.498
2.5	0.085	0.270	0.278	8	0 866	2.761	2.842
3	0.122	0.388	0.400	8.5	0.978	3.117	3.209
3.5	0.166	0 529	0.544	9	1 096	3.495	3.597
4	0.217	0.690	0.711	9.5	1.222	3.894	4.008
4.5	0.274	0.874	0.899	10	1.354	4.314	4.441
5	0.338	1.079	1.110	10.5	1.492	4.756	4.896
5.5	0.410	1.305	1.343	11	1.638	5 220	5.373
6	0.487	1.553	1.599	11.5	1.790	5.706	5.873
6.5	0.572	1.823	1.876	12[1]	1.949	6.213	6.395

Vil man efterse, om Røret gjennem Bunden er i Orden, stænges Kranen d, Pakningsstykket f afskrues, og Blyrøret bøjes noget til Side; man løsner paa Pakningsringen c, Røret a løftes op, indtil dets nedre Ende har passeret Kranen paa Røret b, hvorefter denne afstænges, og Røret a kan løftes helt op og eftersees.

Ved Brugen af Vandloggen maa to Ting haves i Erindring:

1) at Skalaens Nulpunkt eller rettere Snorens Længde fra Flyderen til Vægten, der tjener til Viser paa Skalaen, retter sig efter Skibets Dybgaaende, og

2) Fejlen, der foraarsages ved stadig Krængning.

Med Hensyn til det første Punkt, reguleres dette lettest derved, at man standser Skibets Fart, udtager Trækilen og flytter Loddet paa Nul. Det hele kan udføres i nogle Minutter. Ved de hyppige Stopninger, som Lodning og Skrabning foranledigede, kunde vi paa Nordhavs-Expeditionen altid holde Vandloggen skarpt justeret. Paa Sejlskibe vil Forbruget ombord ikke saaledes forandre Dybgaaendet, som paa Dampskibe, men man bør dog imellem foretage et Par nøjagtige Logninger med den almindelige Log og Uhr, for at kontrollere Vandloggen og eventuelt justere den paany.

[1] Ved 80° Bredde med g = 9.^{m}830 bliver Skalastregen for 12 Miles Fart 1.945 Meter, altsaa kun 4^{mm} forskjellig fra Tabellens. For de mindre Hastigheder bliver Forskjellen forholdsvis mindre.

To ascertain whether the tube passing through the ship's bottom be in order, the stopcock d is turned back, the gland f screwed off, and the leaden tube bent a little aside; then, after partially unscrewing the gland c, the tube a is lifted up till its lower extremity is just clear of the cock of the tube b, and when this too has been turned back, the tube a may be taken out and examined.

When using the water-log, two things must be borne in mind, viz. —

1) That the position of zero on the graduated scale, or rather the length of the line from the float to the weight which plays against the scale, is regulated by the draught of the ship; and

2) The heeling error.

As regards the first source of error, the index is best regulated by stopping the vessel, and then, after taking out the wooden wedge, placing the weight at zero. This may be done in a few minutes. With the frequent stoppages involved in sounding and dredging on the North-Atlantic Expedition, we could always manage to keep the water-log accurately adjusted. In sailing-vessels the draught is not of course as in steamers affected by the consumption of coal: but now and then the speed should nevertheless be closely determined with the common log as a means of testing the results of the water-log, and, if necessary, of adjusting that instrument anew.

[1] In lat. 80° N., where g = 9.830^m, the division on the scale denoting a speed of 12 knots will correspond to 1.945^m, and thus exhibit a difference of only 4^{mm} as compared with the figures in the Table. For less velocities, the difference will be proportionally reduced.

Med Hensyn til det andet Punkt, Krængningsfejlen, da kommer denne i Betragtning kun ved større og stadig Krængning. Slingringernes Virkning er næsten ganske hævet ved Hullets Tranghed og Blænderen. Antages at Stigerøret staar midskibs og vertikalt, naar Skibet ligger paa ret Kjøl, og sættes den lodrette Afstand fra Havniveauet til det Punkt, om hvilket Fartøjet drejer sig, naar det begynder at krænge, lig x, regnet positiv fra Havniveauet nedad mod Kjølen, samt Krængningsvinkelen i og den under denne Krængning paa Skalaen aflæste Fart v', saa har man, idet de tidligere Benævnelser h og v beholdes:

$$v'^2 = 2g\left(\frac{h+x}{\cos i} - x\right) = \frac{2gh + 2gx}{\cos i} - 2gx =$$

$$\frac{v^2 + 2gx\ (1 - \cos i)}{\cos i}$$

$$v^2 = v'^2 \cos i - 4gx \sin^2 \frac{i}{2}$$

x, v og v' maa regnes i samme Enhed (Meter, Fod), Tidsenhed er Sekundet. 1 Kvartmil i Timen svarer til 0.5153 Meter pr. Sekund.

Den følgende Tabel giver en Oversigt over Resultaterne efter denne Formel. Den er beregnet for en Krængning $i = 20°$, og efter Værdierne af $x = 0$, $x = +1^m$ og $x = -1^m$.[1]

The other source of error, viz. heeling, may be ignored altogether, save when the heeling is both great and continuous. The effect of rolling on the water-log will, as a rule, be almost wholly counteracted by the narrowness of the aperture of the tube, and by the blind. Supposing the upper tube, placed amidships, to have a vertical position when the ship is on an even keel, then, if x be the length of the perpendicular from the level of the sea to the point about which she turns on beginning to heel, — assumed positive from the level of the sea towards the keel, — i the heeling-angle, and v' the speed, as read off on the scale with the vessel at that angle, we have, h and v denoting as before, —

$$v'^2 = 2g\left(\frac{h+x}{\cos i} - x\right) = \frac{2gh + 2gx}{\cos i} - 2gx =$$

$$\frac{v^2 + 2gx\ (1 - \cos i)}{\cos i}$$

$$v^2 = v'^2 \cos i - 4gx \sin^2 \frac{i}{2}$$

The value of x, v, and v' must be taken in the same unit of measure (metre, foot). The unit of time is a second. One mile an hour corresponds to 0.5153 metre pr. second.

The following Table gives the results obtained by this formula, taking 20° as the angle of heel, and with the values $x = 0$, $x = +1^m$, and $x = -1^m$.[1]

---

[1] Værdien af x kan findes, naar man krænger Fartøjet, medens det ligger stille, og observerer Krængningsvinkelen i samt Længden o af det Stykke, Vandets Overflade har flyttet sig fra det oprindelige Niveau i Røret. Ligger Niveauet under Krængningen højere, det er over Nulpunktet (Loddet paa Tal paa Skalaen). er x positiv, ligger det lavere (Loddet ovenfor Nulpunktet paa Skalaen), er x negativ. Formelen er:

$$x = o\ \frac{\cos i}{2 \sin^2 \frac{i}{2}}$$

Ex. $i = 20°$, $o = 0.^m05$, $x = 0.^m779$.

Den negative Værdi af x lig en hel Meter er medtaget som Regneexempel for at vise Virkningen af en saadan, omendskjønt den ikke vil forekomme i Praxis.

[1] The value of x may be found by heeling the ship when stationary, and then observing the angle of heel i, together with the distance o, through which the water in the tube has moved from its original level. If the level in heeling be higher, i. e. above zero (the weight within the divisions of the scale), the value of x will be positive; if lower (the weight above zero), x will be negative. The formula is as follows: —

$$x = o\ \frac{\cos i}{2 \sin^2 \frac{i}{2}}$$

Example: $i = 20°$, $o = 0.^m05$, $x = 0.^m779$.

The negative value of x put equal to a whole metre, is introduced merely by way of example, to show its *possible* effect, the case never occurring in practice.

Krængning 20°. *Angle of Heel* 20°.

Observeret Fart. *(Observed Speed.)* Kvartmil i Timen. *(Miles an Hour.)* v'	Virkelig Fart. *(Actual Speed.)* $x = 0$ v	Corr. *(Corr.)*	Diff. f. 1 Kvartmil. *(Diff. for 1 Mile.)*	v Kvartmil i Timen. *(Miles an Hour.)* $x = +1^m$ v	Corr.	$x = -1^m$ v	Corr.
12.0	11.6	—0.4	0.03	11.4	—0.6	11.8	—0.2
9.0	8.7	—0.3	0.03	8.5	—0.5	9.0	0.0
6.0	5.8	—0.2	0.03	5.4	—0.6	6.2	+0.2
4.0	3.9	—0.1	0.03	3.3	—0.7	4.4	+0.4
3.0	2.9	—0.1	0.03	2.0	—1.0	3.6	+0.6
2.5	2.4	—0.1	0.03	1.2	—1.3	3.2	+0.7
2.2	2.1	—0.1	0.03	0.4	—1.8	3.0	+0.8
2.177	2.1	—0.1	0.03	0.0	—2.2	3.0	+0.8
1.0	1.0	0.0				2.3	+1.3

Man ser, at Krængningsfejlen, selv med en saa stor Krængning som 20°, for de større Farter kun udgjør Brøkdele af en Knobs Fart. Svinger Fartøjet om et Punkt i eller nær Vandliniens Flade, er Krængningsfejlene i ethvert Tilfælde meget smaa.

Anderledes stiller Forholdet sig, dersom Stigerøret ikke staar midtskibs. Der kommer da under Krængning en ny Korrektion til, som bliver positiv for Krængning til den ene Side og negativ for Krængning til den anden, og hvis Størrelse voxer med Stigerørets Afstand fra Diametralplanet.

Efter vor Erfaring viste Vandloggen sig særdeles hensigtsmæssig og holdtes med største Lethed i Orden. Et Blik ned i Maskinskylightet var nok til at observere Skibets Fart i Øjeblikket. Maskinisten kunde under Skrabning og Trawling holde Skibet gaaende med den befalede Fart. Til Reduktion af de observerede Vindretninger og Vindhastigheder til sande kræves Skibets Hastighed i Observationsøjeblikket. Denne observeredes paa Vandloggen, der saaledes er et udmærket nautisk-meteorologisk Apparat.

Astronomiske Observationer. Da Expeditionen færdedes paa høje nordlige Bredder om Sommeren, var der ikke Tale om at observere andre Himmellegemer end *Solen* til Bestemmelse af Skibets paaværende Plads. Observationerne gjordes med flere *Sextanter*, der altid var godt verificerede, og hvis Indexfejl stadig blev kontrolleret. Sammenlignende Observationer med forskjellige Sextanter gav altid godt overensstemmende Resultater. Observationspladsen var i Regelen Hyttedækket. I Solobservationernes Udførelse og Beregning deltog, foruden jeg selv og Skibsofficiererne Petersen og Grieg, Professor Mohn og Hr. Tornøe. Solhøjder maaltes til alle Dagstider, naar der var Anledning. I 1878 iagttoges oftere Midnatsolen. Det var kun yderst faa Dage, paa hvilke der manglede Observationer.

It is evident that, with greater speed, the error involved in heeling, even at an angle of 20°, will amount to only a fraction of a mile. And if the point about which the vessel turns lie in or near the plane of the water-line, the error will be generally very small.

The case, however, is different in the event of the upper tube not being amidships. Another correction, positive with a heel to the one side, negative with a heel to the other, will then be needed for computing the speed, and the effect of the heeling will increase with the distance of the upper tube from amidships.

So far as our experience went, we had every reason to be satisfied with the water-log; it answered excellently, and was easy to keep in order. A glance down the engine-room skylight sufficed to tell the ship's speed. Hence, in dredging or trawling the engineer could keep the vessel at the exact rate required. For reducing observations of the wind's direction and velocity to their true value, the speed of the vessel at the moment of observation has to be found. Now, this we took from the water-log, which accordingly proved an excellent instrument for meteorological work at sea.

Astronomical Observations. — The North-Atlantic Expedition having to cruise in high northern latitudes during the summer season, observations of other celestial bodies than the sun for determining the ship's position were of course out of the question. The altitudes were taken with several sextants, accurately verified; the index-error, too, being determined for each separate observation. The results of comparative observations with different sextants never failed to exhibit satisfactory agreement. Our post of observation was, as a rule, the roof of the roundhouse. Besides myself and the ship's officers, Mr. Petersen and Mr. Grieg, Professor Mohn and Mr. Tornøe also assisted in taking the observations and computing their results. Solar altitudes were taken at all hours of the day; nay, on the last cruise, in 1878, we

Kronometrene stod i et Skab i Arbejdssalonen om Bagbord (Fig, 4, c). De blev optrukne hver Morgen og derpaa indbyrdes sammenlignede.

I 1876 havdes 3 Kronometre ombord, et af Kullberg, et af Mewes og et af Frodsham. Det første, der ved den paa Bergens Observatorium af Hr. Åstrand foretagne Undersøgelse før Rejsen viste den jevneste Gang, blev benyttet som Hoveduhr.

I 1877 og 1878 havdes 4 Kronometre ombord, nemlig foruden de 3 nævte. et af Reid, der var Skibet tilhørende. Dette Kronometer viste en saa fortræffelig jevn Gang, at det benyttedes som Hoveduhr de 2 sidste Aar.

Kronometrenes Stand blev bestemt, først paa Bergens Observatorium (undtagen Reid) og senere hovedsagelig ved de telegrafiske Tidssignaler fra Christiania. Disse Signaler gives fra Observatoriet i Christiania hver Onsdag Morgen Kl. 8 Formiddag og hver Søndag Morgen Kl. 9 Form., *Greenwich* Middeltid, til samtlige norske Telegrafstationer. Signalerne gives paa Observatoriet direkte efter Normalpendelen. Der telegraferes hver Gang 3 Signaler, hvert bestaaende af et enkelt Slag fra Nøglen paa Morses Telegrafapparat, nemlig $7^h\ 59^m\ 0^s$, $8^h\ 0^m\ 0^s$ og $8^h\ 1^m\ 0^s$ om Onsdagen og $8^h\ 59^m\ 0^s$, $9^h\ 0^m\ 0^s$ og $9^h\ 1^m\ 0^s$ om Søndagen. For at skille mellem Signalerne betegnes de henholdsvis med 1, 2 og 3 dobbelte Slag strax efter Signalet. Paa Modtagelsesstationen, hvor man indfinder sig med sit Kronometer eller Observationsuhr, høres Signalerne kort og skarpt paa Morses Apparat.

Ved 15 Par korresponderende Solhøjder paa Husø (4° 36′ 57″ øst f. Greenwich) fandt Prof. Mohn den 10de Juni 1876 Kronometret Kullberg $0^h\ 38^m\ 43.3^s$ foran Greenwich Middeltid.

Under Expeditionens Ophold i Reykjavik toges af Lieutn. Petersen og mig den 1ste August 1876 14 Par korresponderende Solhøjder paa en Plads, der ligger omtrent 200 Alen østenfor Kirken. Ifølge velvillig Meddelelse fra Chefen for det Kgl. Danske Søkaart-Archiv, Hr. Kommandør *Rothe,* er, ifølge saavel ældre som nyere Iagttagelser, Længden af et Punkt, der ligger 600 Alen vestenfor Kirken

21° 54′ 46″ W. Greenwich.

Vor Observationsplads ligger saaledes ca. 800 Alen øst for dette Punkt, hvilket, da Bredden er 64° 9′, svarer til 38″ i Længde, og Længden af vor Observationsplads bliver saaledes 21° 54′ 8″ W. Greenwich eller i Tid:

	$1^h\ 27^m\ 36.^s5$
Kronometrets Stand for Stedets Middeltid fandtes	$2^h\ 6^m\ 55.^s7$ foran
altsaa dets Stand for Greenwich Middeltid	$0^h\ 39^m\ 19.^s2$ foran

frequently observed the sun at midnight. The days on which no observations could be taken were very few indeed.

The *Chronometers* we kept in a cupboard in the workroom, on the port side (Fig. 4, c). They were wound up every morning, and duly compared.

On the first cruise, in 1876, we had 3 chronometers, — one by Kullberg, one by Mewes, and one by Frodsham. That by Kullberg, which, previous to the departure of the Expedition, Mr. Åstrand, Director of the Bergen Observatory, had found to have the most uniform rate of the three, was our principal timekeeper in 1876.

In 1877 and 1878 there was a fourth chronometer, one of Reid's, belonging to the ship. This instrument having a remarkably uniform rate, we made it our chief timekeeper on the two last cruises.

The error of each chronometer was first determined at the Bergen Observatory (saving that of the Reid), and afterwards chiefly by comparison with the time-signals telegraphed from Christiania. The observatory of that city transmits these signals every Wednesday morning at 8 a. m. and every Sunday morning at 9 a. m., *Greenwich* mean time, to all Norwegian telegraph-stations. The time is taken at the observatory direct from the standard-clock. Three separate time-signals, each consisting of a single click, are telegraphed, from the key of Morse's apparatus, at intervals of one minute, viz.: — Wednesdays, at $7^h\ 59^m\ 0^s$, $8^h\ 0^m\ 0^s$, and $8^h\ 1^m\ 0^s$; Sundays, at $8^h\ 59^m\ 0^s$, $9^h\ 0^m\ 0^s$, and $9^h\ 1^m\ 0^s$. To distinguish between the signals, they are respectively indicated by double clicks, 1, 2, and 3, following after the signal in the order of succession. At the receiving station, where the observer stands by with his chronometer or hack-watch in hand, the signals come sharp and distinct from Morse's apparatus.

From 15 pairs of equal solar altitudes, taken at Husø (long. 4° 36′ 57″ E.) on the 10th of June 1876, Professor Mohn found the error of Kullberg's chronometer, on Greenwich mean time, to be $0^h\ 38^m\ 43.^s3$ fast.

During the stay of the Expedition at Reykjavik, Lieutenant Petersen and myself took 14 pairs of equal solar altitudes, at a point about 140 yards east of the cathedral. From information kindly furnished by Commodore *Rothe,* Hydrographer to the Royal Danish Navy, it appears that the longitude of a point 410 yards west of the church, has been found, by earlier as well as recent observations, to be —

21° 54′ 46″ W.

Our post of observation was thus about 550 yards east of this point, which corresponds, the latitude being 64° 9′, to 38″ in longitude. Hence, our post of observation was in

Longitude 21° 54′ 8″ W., or in time	$1^h\ 27^m\ 36.^s5$
Error of chronometer on mean time of place	$2^h\ 6^m\ 55.^s7$ fast;
therefore on Greenwich mean time	$0^h\ 39^m\ 19.^s2$ fast.

I nedenstaaende Tabeller er givet en Oversigt over Hovedkronometrets Stand og Gang under vor Expedition.

1876. Kronometer Kullberg.

Dag.	Stand foran Gr. Middelt.	Daglig Acceleration.	Sted.
Mai 30	$0^h\ 38^m\ 37.^s8$	0.^{s}66	Bergens Observatorium.
Juni 10	38 43. 3	0. 50	Husø. Corr. Højder.
Juni 26	38 59. 6	1. 02	Kristiansund. Tel. Sig.
Aug. 1	39 19. 2	0. 54	Reykjavik. Corr. Højder.
Aug. 20	39 33. 6	0. 76	Namsos. Tel. Sig.

Sammenstilles de Værdier af Kronometrets Stand, som er benyttede ombord, med de som følger af Tabellens Tal ved ligefrem Interpolation, saa finder man, at den største Forskjel falder den 22de Juli, da den brugte Stand er $39^m\ 21^s$ og den efter Tabellen fundne $39^m\ 14^s$. Forskjellen er 7^s i Tid eller 1.′75 i Bue af Parallelgraden. Da Bredden her var mellem 63° og 64°, bliver Fejlen i Storcirkelbue 0.′78, en saa liden Størrelse, at vi i vore Opgaver over Skibets (Stationernes) paaværende Plads har beholdt de under Rejsen bestemte Værdier af Bredder og Længder. Den næststørste Afvigelse mellem den benyttede og beregnede Værdi af Kronometrets Stand findes den 13de August, da den er -5^s, hvilket svarer til en Afstand af 0.6 Kvartmil.

1877. Kronometer Reid.

Dag.	Stand efter Gr. Middelt.	Daglig Retardation.	Sted.
Maj 23	$0^h\ 7^m\ 23.^s0$	0.^{s}90	Bergen. Tel. Sig.
Juni 24	7 54. 0	0. 97	Bodø. do.
Juli 11	8 10. 0	0. 94	Tromsø. do.
Juli 22	8 21. 2	1. 02	Tromsø. do.
Aug. 12	8 39. 5	0. 86	Bodø. do.

Ved Ankomsten til Bodø den 23de Juni var den beregnede Stand af Kronometret $7^m\ 51^s$, og den af Verifikationen den følgende Dag udledede $7^m\ 53^s$, altsaa en Forskjel af 2^s, der paa 67° Bredde svarer til en Afstand af 0.2 Kvartmil. Ved Tilbagekomsten fra Jan Mayen beregnedes Observationerne ombord den 9de August udenfor Lofoten med en Kronometerstand af $8^m\ 39^s$. Den efter Verifikationen i Bodø den 12te August bestemte Stand er $8^m\ 36.^s7$. Forskjellen, 2.^{s}3, svarer til en Afstand af 0.2 Kvartmil.

1878. Kronometer Reid.

Dag.	Stand efter Gr. Middelt.	Daglig Retardation.	Sted.
Juni 23	$0^h\ 15^m\ 4.^s5$	1.^{s}00	Hammerfest. Tel. Sig.
Juli 10	15 19. 0	0. 85	do. do.
Juli 28	15 36. 5	0. 97	do. do.
Aug. 28	16 6. 8	0. 98	Tromsø. do.

Dén 7dę Juli, da sidste Observation toges Dagen før Tilbagekomsten til Hammerfest paa første Tur, regnedes

In the following Tables are set forth the error and rate of our chief chronometer.

1876. Kullberg's Chronometer.

Date.	Chron. Fast on G. M. T.	Gaining daily.	Place.
May 30	$0^h\ 38^m\ 37.^s8$	0.^{s}66	Bergen Observatory.
June 10	38 43. 3	0. 50	Husø. Equ. Altit.
June 26	38 59. 6	1. 02	Christiansund. Tel. Sig.
Aug. 1	39 19. 2	0. 54	Reykjavik. Equ. Altit.
Aug. 20	39 33. 6	0. 76	Namsos. Tel. Sig.

By comparing the assumed values of the error of the chronometer with those deduced, by simple interpolation, from the figures in the Table, the greatest difference is found to have occurred on the 22nd of July, the assumed error having been $39^m\ 21^s$ as against $39^m\ 14^s$, the error determined from the Table, — a difference of 7^s in time, or 1.′75 in arc of parallel of latitude. The latitude was between 63° and 64°, which reduces the error, in arc of great circle, to 0.′78, an error so small that we did not hesitate, when recording the position of the ship, to retain the latitudes and longitudes determined on the cruise. The next greatest difference between the observed and computed error occurred on the 13th of August; it was 5^s, which corresponds to 0.6 of a nautical mile.

1877. Reid's Chronometer.

Date.	Chron. Slow by G. M. T.	Losing daily.	Place.
May 23	$0^h\ 7^m\ 23.^s0$	0.^{s}90	Bergen. Tel. Sig.
June 24	7 54. 0	0. 97	Bodø. do.
July 11	8 10. 0	0. 94	Tromsø. do.
July 22	8 21. 2	1. 02	Tromsø. do.
Aug. 12	8 39. 5	0. 86	Bodø. do.

On our arrival at Bodø, June 23rd, the computed error of the chronometer was $7^m\ 51^s$, whereas the error found next day by verification amounted to $7^m\ 53^s$, making a difference of 2^s, which, on the 67th parallel of latitude, corresponds to a distance of 0.2 of a nautical mile. When returning from Jan Mayen, observations taken on the 9th of August, off Lofoten, were calculated with an assumed error of $8^m\ 39^s$. The error found by verification at Bodø on the 12th of August was $8^m\ 36.^s7$. The difference, 2.^{s}3, corresponds to 0.2 of a nautical mile.

1878. Reid's Chronometer.

Date.	Chron. Slow by G. M. T.	Losing daily.	Place.
June 23	$0^h\ 15^m\ 4.^s5$	1.^{s}00	Hammerfest. Tel. Sig.
July 10	15 19. 0	0. 85	do. do.
July 28	15 36. 5	0. 97	do. do.
Aug. 28	16 6. 8	0. 98	Tromsø do.

For our last observation on the first cruise of the Expedition, taken July 7th, the day before returning to

Der findes imidlertid blandt vore Stationer nogle, hvor Usikkerheden af den paaværende Plads gaar op til 5 à 6 Minuter, nemlig udenfor den nordvestlige Del af Spidsbergen, nordenfor 78° Bredde. Efterat den paaværende Plads var bestemt ved Solobservationer saavel Formiddag som Eftermiddag, viste det sig, da vi fik Land i Sigte, at Resultatet af Pejlinger af Nordpynten af Pr. Charles Foreland gav en 5′ til 6′ sydligere Plads end Solobservationerne. Men Aarsagen viste sig ogsaa i en stærk Hildring, der krævede en anden Værdi for Kimmingdalingen end den normale, som var benyttet. Under saadanne Forhold er paaværende Plads umulig at bestemme med vanlig Nøjagtighed efter Solobservationer, selv om man laa for Anker og observerede Højder i alle Azimuther, thi Horizontalrefraktionen vil variere med Retningen og med Dagstiden paa en ganske uperiodisk Maade, der er umulig at bringe i Regning. Et lignende Exempel paa Virkningen af Hildring havde vi om Morgenen den 10de August 1877 udenfor Lofoten. Maaling af Horizontalvinkler mellem kjendte Punkter gav Fartøjet en paaværende Plads, der laa i en betydelig Afstand fra den Stedlinie, som en over den østlige, falske Horizont maalt Solhøjde gav.

Til Slutning skal jeg nævne, at Expeditionen var udrustet med Apparater til at maale Strøm i Overfladen og paa Dybet. Disse kom ikke til Anvendelse, først fordi Vejret det første Aar var saa særdeles ugunstigt, og senere fordi de andre Arbejder, som skulde udføres, krævede al vor Tid og ikke turde forsinkes af Operationer, om hvilke det altid maatte være tvivlsomt, hvorvidt noget brugbart Resultat kunde erholdes. Bestemmelser af Strømmen i Overfladen efter den almindelige nautiske Methode lod sig ikke, undtagen i yderst faa Tilfælde, udføre paa vor Expedition, da Sejladsen under Skrabning, som nævnt, umuliggjorde et skarpt Bestikhold.

Meanwhile, for some of our observing-stations, the possible error of the ship's position amounts to from 5 to 6 miles, viz. those off the north-western extremity of Spitzbergen, in latitude from 78° to 80° N. After determining the ship's position by observations of the sun's altitude, taken before as well as after noon, we found, on sighting land, the bearing of the northern promontory of Prince Charles' Foreland to give a point from 5 to 6 miles farther south than that determined by the solar altitudes. This, however, was obviously the result of mirage; and hence our constant value for the dip of the horizon would not serve. Under such circumstances it is impossible, were the ship at anchor even and the altitudes observed in all azimuths, to determine her position with the usual accuracy by observations of the sun, since the horizontal refraction according to the direction and the time of day will not vary periodically, and its true value cannot be taken into account. A similar instance of the effects of mirage occurred on the morning of the 10th of August 1877, off Lofoten. By measuring horizontal angles between known objects, we found the ship's position to be a considerable distance from the line of equal altitudes marked out from observations of the sun above the eastern delusory horizon.

Finally, I must not omit to mention that the Expedition was provided with instruments for determining both surface and deep-sea currents. These apparatus, however, were not made use of, — at first owing to the very unfavourable weather we encountered on the opening cruise, and afterwards to avoid impeding the chief exploratory work by operations from which it was anything but certain that practical results would be obtained. Nor had we, save in a very few cases, opportunity of determining the surface-current in the usual nautical way, the effect of dredging and trawling, as stated above, inevitably putting us out of our reckoning.

Translated into English by **John Hazeland.**

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

IV.

1. HISTORICAL ACCOUNT.

WITH ONE MAP.

2. THE APPARATUS AND HOW USED.

WITH A FRONTISPIECE AND 21 ILLUSTRATIONS.

BY

C. WILLE,
CAPTAIN OF THE ROYAL NAVY.

CHRISTIANIA.
PRINTED BY GRONDAHL & SON.
1882.

LEIPZIG, K. F. KÖHLER. **LONDON,** SAMPSON, LOW, MARSTON, SEARLE & RIVINGTON. **PARIS,** K. NILSON.